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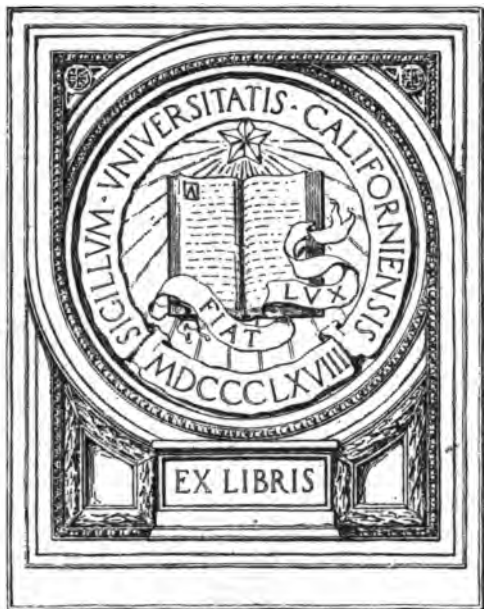
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**INSTRUCTIONS FOR MOUNTING,
USING, AND CARING FOR**

8-INCH DISAPPEARING CARRIAGES

L. F., MODEL OF 1896

FOR

8-INCH GUN

MODELS OF 1888 M1 AND M11

(FIVE PLATES)

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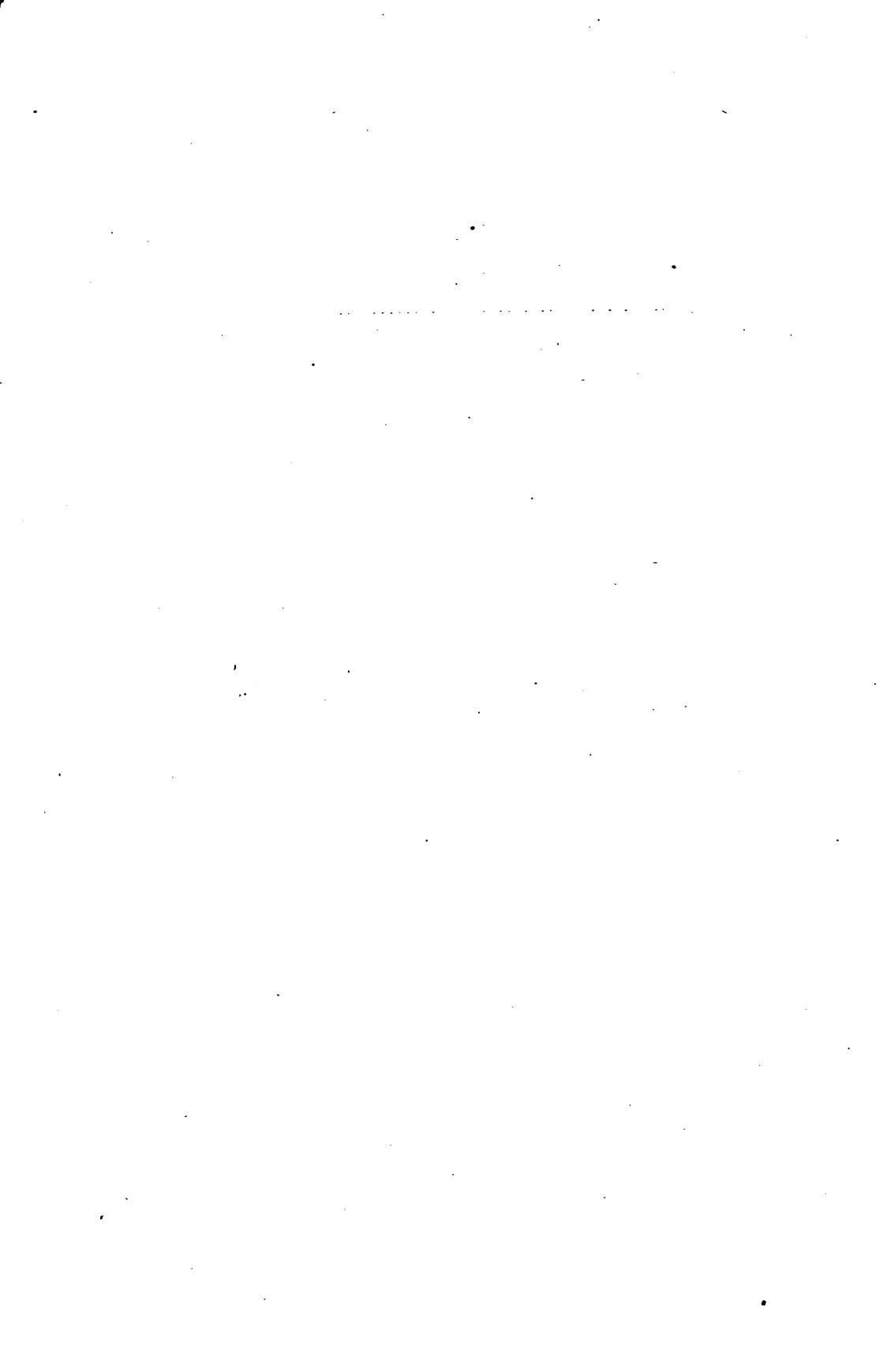
By order of the Secretary of War:

WILLIAM CROZIER,
Brigadier General, Chief of Ordnance.



TABLE OF CONTENTS.

	Page.
List of plates.....	7
General description:	
Carriage.....	9
Action of.....	9
Top carriage.....	10
Recoil and counter-recoil system.....	10-11
Action of recoil system.....	11-12
Filling recoil cylinders.....	12-13
Recoil buffers.....	13
Regulation of recoil.....	13
Counter-recoil buffers.....	13
Chassis.....	13-14
Base ring and racer.....	14
Traversing gear.....	14-15
Elevating gear.....	15
Elevation scale and pointer.....	15-16
Elevating counterbalance device.....	16
Retracting gear.....	16
Ammunition truck.....	16
Sighting standard and platforms.....	16
Limits of motion.....	17
Lanyard attachment.....	17
General remarks.....	17
To assemble the carriage.....	18-21
Care of the carriage—General instructions:	
Cleaning recoil cylinders.....	21-22
Removing packing from stuffing boxes.....	22
Filling recoil cylinders.....	23
Service condition.....	23
Condition "in ordinary".....	23-24
Oil holes.....	24
Compression grease cups.....	24
Oils, grease, etc.....	24-25
Painting, etc.....	25
List of articles packed in armament chest for 8-inch guns, models of 1888 M I and M II, and 8-inch disappearing carriage, L. F., model of 1896.....	25
List of implements furnished for 8-inch gun, model of 1888.....	26
List of equipment supplied for 8-inch gun, model of 1888 M I and M II, and disappearing carriage, L. F., model of 1896.....	26
Material for cleaning and preservation of 8-inch gun, model of 1888 M I and M II, and disappearing carriage, L. F., model of 1896.....	26
Weights of the principal parts of 8-inch disappearing carriage, L. F., model of 1896.....	27
Names of parts, location, etc.....	27-41



LIST OF PLATES.

	Drawing No.
I. Platform.....	8-9-29
II. Longitudinal section (movement).....	8-9-1
III. End views.....	8-9-2
IV. Method of controlling energy of recoil.....	15-0-1
V. Elevating and retracting gearing.....	8-9-4

INSTRUCTIONS

FOR

MOUNTING, USING, AND CARING FOR 8-INCH DISAPPEARING CARRIAGES, L. F., MODEL OF 1896.

(FIVE PLATES.)

[The points printed in *italics* are of importance or concern the safety of the carriage, and should be specially noted. The important changes are shown in **bold-face type**.]

GENERAL DESCRIPTION.

THE CARRIAGE (Plates II and III).—This carriage consists of the following principal parts, viz: Gun levers, counterweight, top carriage, chassis, racer, traversing rollers, base ring, transoms, traversing gear, elevating gear, retracting gear, tripping device, and ammunition truck and tongs.

ACTION.—The action of the carriage is as follows:

Upon firing the piece, the gun-lever axle moves to the rear, carrying the top carriage with it. The lower ends of the levers move vertically upward, being constrained by the crosshead guides. The trunnions of the gun move downward and to the rear in the arc of an ellipse.

The energy of recoil is absorbed partly by raising the counterweight, but mostly by the resistance of the recoil cylinders.

When the gun comes to rest, it has the proper loading angle. After loading, the pawls are tripped and the greater moment of the counterweight enables it to raise the gun to the firing position.

The trunnions of the gun rest in bronze-bushed trunnion beds at the upper ends of the gun levers. These levers are made of cast steel and are pivoted near their middle points upon an axle of forged steel which rests in bronzed-bushed bearings in the top carriage.

The lower ends of the gun levers are joined by lever pins to a cast-steel crosshead on the sides of which are clips, lined with bronze, engaging over crosshead guides cast on the inside of the chassis. These guides constrain the crosshead to move in a vertical direction. Ratchet teeth, numbered from the top, are cut on the front faces of the crosshead clips to be caught by pawls pivoted to the chassis, and in this way the crosshead, to which the counterweight is attached, is held up and the gun is prevented from returning to the firing position after recoiling.

The counterweight, consisting of lead plates, rests upon a bottom plate of cast iron, strengthened by ribs, which plate is suspended

from the crosshead by two rods secured to the crosshead by pins placed just below those for the gun levers. The five lead plates, which lie wholly below the bottom of the crosshead, are cylindrical, 8.8 inches high and 46.5 inches diameter; the upper ones being of irregular shape in order to be piled in and around the crosshead, the outside form of the entire counterweight being, however, cylindrical. The top layer is divided into small blocks, which are provided with rings for easy handling. By means of these smaller weights the counterweight can be readily increased or diminished.

When the counterweight is assembled it forms a cylindrical pile approximately 5 feet high. In its lowest position it hangs in a well formed in the platform concentric with the base ring, 7 feet 11 inches in diameter and approximately 4 feet 6 inches deep, measured from the underside of the base ring.

After the gun is loaded it is permitted to rise to the firing position by tripping the pawls. *This may be done on either side or on both sides simultaneously by raising the tripping levers attached to the ends of a through shaft, connected by cranks and links to the pawl lever.*

The tripping levers when raised are held up by the safety latch which engages a stud on the right pawl lever, thus holding the pawls forward and free of the crosshead racks. When the latter have passed below the pawls, a dog on the crosshead strikes the safety latch and disengages the pawl levers, which automatically return to their normal position. The pawls are then ready to engage the racks when the gun again recoils.

THE TOP CARRIAGE.—The top carriage, of cast iron No. 2, consists principally of two trunnion-bed side frames surmounting two recoil cylinders which are united by a transom.

The top carriage runs upon live rollers of forged steel 4 inches in diameter, having flanges projecting over the roller path and serving as guides. The rollers on the same side are constrained to move together by being mounted in a frame. Two flanges project downward from the outside of each recoil cylinder. (The earlier carriages of this model have also two flanges on the inner side of each cylinder.) The rear outside flanges are clipped under flanges on the tops of the chassis rails, while the others serve merely as guides for the top carriage in motion. The forward guides are also arranged to serve as fulcrums for pinching bars held horizontally and engaging in notches cast on the outside of each chassis just below and near the front of the top carriage, by which arrangement the top carriage may be moved forward to the firing position if from any cause it should stop short of it.

RECOIL AND COUNTER-RECOIL SYSTEM (Plate IV).—The recoil cylinders are 8 inches in interior diameter, fitted with piston rods 3 inches in diameter having pistons formed out of the solid and working in the cylinders with a diametrical clearance of 0.02 inch.

The piston rods pass through lugs which project upward from the front ends of the chassis rails, and are secured by the piston-rod nuts and check nuts.

The piston rods project through the rear ends of the cylinders, and are supported in rear by brackets bolted to the ends of the chassis rails. At the ends of the cylinders there are the usual stuffing boxes. During recoil the pistons remain stationary, and the top carriage, with its recoil cylinders, is drawn along them.

To secure equal fluid pressure in the two cylinders, an equalizing pipe connects their front or pressure ends. In this pipe is an emptying coupling by which the whole recoil system can be emptied of oil. From this coupling a connecting pipe extends back to the throttling valve, and from this valve pipes connect with the rear ends of the cylinders.

Bronze plugs are provided, to be screwed into the cylinders in place of the equalizing and throttling pipes, thus continuing the piece in action should the pipes be destroyed.

A small part only of the energy of recoil is taken up by the raising of the counterweight and by the movement of the top carriage up its inclined path, the greater portion is, however, absorbed by the resistance of the hydraulic cylinders.

In any hydraulic brake the resistance is greater as the velocity of the piston in the cylinder is greater and as the openings for the passage of the liquid are smaller. The velocity of retarded recoil of the top carriage being variable and a constant resistance being desired, the orifices are varied in such manner that the relation between the velocity and the area of the orifices is at all points such as to give a nearly constant resistance.

The general arrangement of the hydraulic cylinders, pistons, equalizing and connecting pipes, throttling valve, and emptying coupling is shown on Plate IV, to which the parts of this carriage conform in essential principles, features, and positions. The relative positions of parts shown on that plate are those which exist in the "in battery" position.

ACTION OF RECOIL SYSTEM.—When the gun is fired the pistons remain stationary, while the top carriage (in which are the cylinders) moves to the rear. The motion of the top carriage is retarded and finally stopped, principally by the resistance which the oil in the cylinders offers to being forced from one side of the piston to the other, through the following openings, viz:

1. The clearance between the walls of the cylinder and the piston necessary for working movement. This opening is of constant area.
2. The orifices between the throttling bars and their slots in the piston. These openings vary with the profile of the throttling bars, since the slots in the pistons are of constant area.
3. The opening of the throttling valve which controls the flow through the pipes connecting the front and rear ends of the cylinders. This opening is of constant area during recoil, but can be completely closed or changed to suit different conditions of loading and to correct for any other conditions that would cause a variation in the length of recoil.

The two throttling bars in each cylinder are constructed of constant width, with only a sufficient lateral clearance in the slots for working movement, and of varying depth, the profile being so designed that the area of the orifices (the portions of the slots in the pistons not filled by the bars), through which the oil escapes past the piston, increases from the beginning of motion up to the point where the velocity of retarded recoil of the top carriage is greatest; beyond this point the velocity of retarded recoil of the top carriage is continually decreasing, and the areas of the orifices decrease continually until they become zero at the end of recoil. The orifices have at each point of recoil such a relation to the velocity of retarded

recoil of the top carriage at that point as to give a nearly constant resistance to the motion of the top carriage. This results in a nearly constant fluid pressure in the cylinders.

The areas of the orifices have to be calculated for a particular set of conditions of loading and for a mean temperature (75° F.), and any variation in these conditions will change the length of recoil of the top carriage. As the standard conditions of loading do not always exist, it has been found desirable to provide means for varying the resistance of the hydraulic-recoil brake in order that the prescribed length of recoil (bringing the gun into the prescribed loading position) may be obtained under any conditions, standard or not standard, as, for example, when practice charges are fired.

For this purpose the equalizing pipes connecting the two cylinders are joined to another pipe, affording a passage for the oil, which can be completely closed or changed in area by the *throttling valve* and by which the oil can pass from one end of the cylinders to the other without flowing through the throttling-bar orifices.

This throttling valve can be adjusted to give openings varying by 0.013 square inch from 0 to 0.40 square inch.

The graduations of the valve are stamped on the top of the body, there being ten divisions, numbered 0.04, 0.08, etc. To change the setting by 0.04 requires one and one-half complete revolutions of the valve yoke. One complete turn of the valve effects a change of 0.026 square inch in the opening. One half turn effects a change of 0.013 square inch.

The setting of the valve best suited to different conditions of loading, full or practice charges, etc., can be determined only by experience in actual firings with each particular carriage. Different carriages may require different settings, and the same carriage may even at different times require different settings for the same conditions of loading if it is in a materially different condition as to cleanliness and lubrication of the working parts, etc. However, the loading position may vary considerably without material inconvenience, and it is generally possible after a few firings with a carriage to determine the settings of the valve which will result in the gun coming into proper loading position for any conditions of loading.

For full charges the valve should, in the lack of experience with the particular carriage, be opened to about 0.1 square inch, but not more.

A padlock is provided for locking the valve yoke in any position to guard against accidental or unauthorized changes in the position of the valve after it has been set. The valve should habitually be kept locked, but this should not be understood as discouraging examination and manipulation of the valve, which are, on the contrary, highly desirable for the sake of familiarizing the personnel with its construction and operation.

FILLING RECOIL CYLINDERS.—Each cylinder is provided with one filling plug, and an emptying plug is placed in the coupling of the equalizing pipe. In filling, the filling plugs should be removed from both cylinders, so as to permit the air to escape and thus insure the filling of both cylinders up to the filling holes.

The portion of each cylinder above the level of the filling hole (about 45 cubic inches in each cylinder) is intended to be empty, this being for the purpose of allowing the oil sufficient space in

which to expand, when heated by weather or the friction developed in firing, and to provide a space into which the plunger of the counter-recoil buffer may be withdrawn. This withdrawal is accomplished so rapidly in recoil that the oil can not flow through the small clearances with sufficient rapidity to fill the seat of the buffer without causing a high pressure in the cylinders.

For all charges the cylinders should, before firing, be filled to the level of the filling holes, as above described.

A neutral oil, of specific gravity of about 0.85 (such as the "hydro-line" at present issued), is used, and with this oil the working pressure in the cylinders is about 900 pounds per square inch. A denser oil would cause a higher pressure in the cylinders and therefore shorten the recoil slightly. About 15.5 gallons of oil are required to fill the cylinders and pipes of the carriage.

RECOIL BUFFERS.—For the purpose of reducing the shock of accidental excessive recoil, recoil buffers, made up of alternate layers of balata and steel plates, are placed on brackets bolted to the rear ends of the chassis, where they will be struck by the upper ends of the gun levers if the gun recoils beyond its proper position.

REGULATION OF RECOIL.—The notches between the ratchet teeth, cut on the front faces of the crosshead clips, are numbered from the top, the numbers being opposite the notches on brass strips screwed to the crosshead. When the top pawl teeth engage in the twentieth notch the gun is in its calculated loading position, *below which it should not be retracted*. By a proper adjustment of the throttling valve the recoil of the gun should not vary much from this position. The ammunition truck will, however, permit the gun to be loaded in a position varying considerably from that prescribed.

From the foregoing description of the recoil system it should be evident that should the carriage recoil too freely the proper correction is in a diminution of the opening of the throttling valve, not in an increase of the counterweight. On the other hand, the counterweight alone should be changed to correct or modify the counter recoil.

The amount of counterweight can be determined by trial. However much of the counterweight furnished be used, it will not materially affect the length of recoil.

COUNTER-RECOIL BUFFERS.—Counter-recoil buffers are formed by the enlarged parts of the piston rods directly in rear of the pistons, fitting into cups in the rear cylinder heads with a diametral clearance of 0.01 inch at the beginning and of 0.005 inch at the ends of the enlarged parts.

When the gun returns to the firing position, the liquid caught in the recesses in the cylinder heads can only escape by the small clearance, thus acting as a buffer to check the velocity at the end of the return into battery.

To prevent the enlarged parts of the piston rods from bottoming in the cylinder-head recesses, the top carriage is arranged to abut, when in the firing position, against counter-recoil stops at the front ends of the chassis rails.

CHASSIS.—The chassis, of cast iron No. 2, are bolted to the racer and are united near their middle part by one cast-steel transom. When in place the upper surfaces of the chassis rails of carriages, numbered 1 to 35, inclusive, have a slope of 1 degree, and from 36 to

38, inclusive, a slope of 1.5 degrees to the front to facilitate the return of the gun to the firing position and to reduce the necessary preponderance of the counterweight. ■

BASE RING AND RACER.—The racer is made of steel, cast in one piece, having an outside diameter of 11 feet 9 inches.

On its underside there is an annular projection 2 inches thick, which is accurately turned to a diameter of 104 inches. This projection fits into a corresponding projection from the base ring, bored to 104.04 inches diameter. The contiguous surfaces of the racer and base ring thus form a pintle joint having 0.04 inch diametral clearance.

The pintle surface of the racer has a spiral groove for facilitating lubrication, and there are four oil holes closed by screw plugs so located on the racer as to lead to the oil groove at its highest point. *When lubricating through these holes the carriage should be traversed in order that the whole circumference of the pintle may receive oil.* On the underside of the racer is formed the upper roller path.

The base ring, made of cast iron No. 2, in one piece, is bolted to the platform by twelve 1.75-inch bolts, projecting from the platform through the base ring and secured by hexagon nuts. There are also twelve 1.75-inch bronze leveling screws tapped in the base ring and bearing on steel thrust plates beneath. The base ring contains, in addition to the pintle, the lower roller path, formed on its upper surface. A circle of twenty-four forged-steel conical rollers, securely held in place by two concentric distance rings, rests upon the lower roller path. The system is held concentric by flanges on the inner ends of the rollers.

Two cast-steel clips are bolted to the top of the racer in front and engage under an interior flange formed on the base ring.

There is a dust guard outside of the roller-ring system, formed of six sections of steel plate, bolted to the racer, and additional protection against dust is afforded by a felt-ring bolted to the bottom of the steel dust guard on the inside.

A brass azimuth circle, attached by countersunk screws to the top of the pintle of the base ring, is graduated to degrees, but the numbers are to be added after the carriage is erected in its emplacement. The top of the racer is cut away in front to expose the azimuth circle, and an azimuth pointer, with index and subscale remaining in smooth contact with the azimuth circle, is provided, the whole being protected by a cover. The frame of the subscale has slotted holes to give it a lateral motion for adjustment, after which it is fixed in position by two dowels. The least reading on the subscale is one-tenth of a degree. The pointer is made to slide along the subscale by a screw, the head of which is graduated into ten equal parts, making the least reading one-hundredth of a degree.

The azimuth pointer of the earlier carriages is a brass plate with the subscale, graduated to twentieths of a degree, along its lower edge. The screw holes for attaching this design of pointer to the racer are slotted to allow adjustment. When adjusted the pointer is fixed in place by dowels. A dust guard, with a rectangular hole through which the pointer projects and the azimuth circle is seen, is provided for this pointer and serves to cover up a large part of the cut in the racer.

TRAVERSING GEAR.—For pointing the carriage in azimuth, two crank handles attached to a horizontal transverse shaft in the front

of the chassis and just above the racer are provided, to be maneuvered by men standing on the platform. These handles actuate a train of gears engaging a forged-steel traversing rack made in six sections and bolted to the inside of the base ring.

ELEVATING GEAR (Plate V).—For pointing in elevation, a hand-wheel is provided on each side of the carriage, to be maneuvered by men standing on the racer. The handwheels actuate, through a train of worm and spur gearing, cast-steel elevating racks, working over guides bolted to the inner faces of the chassis. *A lug is cast on the rear part of each rack and two holes are drilled in each chassis rail, in one of which holes a stop bolt is inserted, against which the lugs strike to limit the depression of the gun to 0 or 5 degrees, depending on the parapet over which the gun is to be fired.*

ELEVATING SCALE AND POINTER.—At the left end of the elevating wormwheel shaft there is secured a disk carrying on its periphery a white metal ring. One edge of the ring is graduated in yards for sub-caliber range and the other edge is graduated in yards for service ranges. The elevation scale is graduated in 5° spaces. The relations of the parts of the elevating mechanism are such that the successive 5° spaces are not of the same length of arc, requiring the scale to be graduated by the use of a clinometer supported by a rest placed in the muzzle of the gun after the gun is mounted upon the carriage, at the time of the shop test. As the ranges corresponding to different angles of elevation above the horizontal depend upon the height at which the gun is mounted above the sea level, the range scales must be graduated after mounting, the ranges corresponding to the different angles of elevation for the height above sea level, and for the muzzle velocity normally used must be calculated from the range tables and formulas and marked upon the scale in the proper place. This should never be done except under the supervision of the Ordnance Department.

The wormwheel is mounted loosely on this same shaft, but bears against a thrust collar. The inside of the rim of the wormwheel is coned, and in contact with the coned surface is a coned friction wheel constrained by a key to rotate with its shaft, but capable of motion in the direction of its axis. By means of two nuts on the shaft the friction wheel may be held in contact with the wormwheel, so that any desired amount of friction can be obtained.

The nuts for adjusting the friction should be set up to prevent the elevating racks from running down when a weight of 9,000 pounds is attached to the elevating arm, the gun being at 0° elevation.

By this means any dangerous strains to the elevating mechanism during firing are avoided.

The elevating racks have journals cast on them, to which the elevating arm is attached. This arm is of cast steel, in one piece, and is 110.5 inches long from center to center of journal bearings. The upper ends of the elevating arms are attached to journals on the cast-steel elevating band on the gun.

A spring buffer is attached to each chassis near the bottom of the elevating-rack guides to prevent any shock, if by chance the friction clutch is released and the racks run down of their own weight, and also to serve as an elastic stop for elevation.

While theory requires, in order that the gun, when recoiled to the twentieth notch, shall always return to the same angle for loading, whatever may be the firing angle, that the elevating rack shall be

circular and struck with a radius equal to the length of the elevating arm, using the center of the journal on the elevating band when the gun is in the loading position as a center, yet certain difficulties—as well as expense in manufacture—have made it more convenient to make the racks straight. These are so placed, however, as to cause only a slight variation in the loading angle, which is about 5 degrees. On account of the character of the motion, the distance between the graduation marks on the elevation disk is not constant, requiring that the disk be graduated after the gun is mounted.

ELEVATING COUNTERBALANCE DEVICE.—A device has been designed to equalize the power required for elevating and depressing when the gun is in battery, and to counterbalance the weight of the elevating racks and one-half the weight of the elevating arm when the gun is from battery.

This device consists of a weight supported by a wire rope which passes over pulleys secured to the racer and is attached to the elevating system. The device has been tested with satisfactory results, and is to be added to all disappearing carriages in service.

RETRACTING GEAR (Plate V).—For hauling the gun down by hand two crank handles, to be maneuvered by men standing on the racer, are provided. These cranks actuate, through a train of spur gearing, two drums, the wire ropes for which pass around guide pulleys in rear of the recoil buffers, and during retraction are hooked to the upper ends of the gun levers in rear of the gun trunnions.

The other ends of the ropes are attached to the drums. The ropes remain with the carriage, and, when not in use, are wound upon the drums until their ends project but a few inches from the guide-pulley brackets.

A handwheel is placed on the retracting-crank shaft on the left side of the carriage for running out the ropes and for taking up the slack of the ropes after they have been attached to the gun levers, *taking care that the ropes follow the grooves in the drum.*

AMMUNITION TRUCK.—The ammunition is served to the gun on an ammunition truck. The projectile tray is so arranged that the projectile can easily be raised to the proper height for loading, and may also be given practically the same elevation that the gun has in the loading position. The truck is furnished with a brake.

SIGHTING STANDARD AND PLATFORMS (Plates II and III).—A sight standard is placed above the rear part of the right chassis rail. The bracket attaching it to the chassis serves to support the end of the right piston rod. Set screws are provided at the socket for making slight adjustments in rotation and fixing the standard with the line of collimation of the telescope in a vertical plane parallel to a vertical plane containing the axis of the bore.

A sighting platform is built in rear of the standard, on brackets bolted to the chassis, and it is reached by means of a ladder attached to it in rear.

Another sighting platform is attached to the top carriage, just above the right recoil cylinder, to be used when a sight is placed on the right trunnion. This platform is reached by means of steps on the right chassis and a small ladder attached to the top carriage. A small handrail on the right gun lever is also provided.

LIMITS OF MOTION.

There are plates on the carriage indicating the direction of motion of the elevating handwheels in elevating or depressing the gun, and that of the cranks for traversing and retracting.

The gun can be elevated from -5° to $+12^{\circ}$, and the carriage permits of its being mounted in an emplacement in which the gun can be traversed through 170° . Stops on the base ring above the traversing rack limit the motion of the carriage in azimuth depending upon the emplacement in which it is mounted.

All axle, trunnion, and sliding bearing surfaces are provided with oil holes closed by screw plugs, the trunnions of the gun, gun-lever axle, and gun-lever pins being also provided with grease cups.

LANYARD ATTACHMENT.

To prevent firing of the piece by a pull, accidental or otherwise, upon the lanyard before the gun has risen to the firing position, the lanyard is made in two parts, one from the primer to a ring attached to the safety device, the other from that ring to the loading platform of the emplacement, where it is to be pulled by a cannoneer. To the ring to which these two lanyards are attached is fastened a wire cord which passes around and is wound upon a reel carried in a housing attached to the rear face of the elevating band of the gun. A spiral spring causes this reel to rotate so as to wind up the cord and keep it wound up unless it is pulled out against the action of the spring. This unwinding is prevented by the engagement, in ratchet notches on the reel, of a spring-actuated pawl, which is automatically released when the gun has reached the firing position by a cam attached to the rear face of the upper end of the elevating arm; that is, when it has been raised to such a height that the projectile will clear the parapet. As before this the reel can not turn, the wire cord can not unwind, and the short lanyard can not be pulled to the rear sufficiently to bring any pull whatever on the primer wire. The long lanyard having no connection with the short one except through the ring on the wire cord coming from the reel, a pull upon this long lanyard does not affect the short lanyard or the primer until the pawl is released and the wire cord is pulled out against the resistance of the spring, at which time it is safe to fire.

GENERAL REMARKS.

An elevating band, seven pairs of shot tongs, three ammunition trucks, and the necessary tools and implements are furnished with each carriage.

The amount of lead counterweight furnished with each carriage is approximately 500 pounds in excess of that required to raise the gun to the firing position under normal conditions, *but at all times the counterweight should be such as will raise the gun fully to the firing position, yet without great shock on the counter-recoil stops.*

TO ASSEMBLE THE CARRIAGE.

This requires machines and implements for mechanical maneuvers usually found at forts; but in addition to falls, blocking, jacks, sling chains, etc., a pair of shears, capable of lifting 5 tons, will be found especially useful. These are fully described in Tidball's Manual, page 284.

The size and weight of the carriage permit it to be transported by rail to almost all locations partially assembled, so that when it arrives at its destination only a few of the larger parts have to be put in place, namely: Sight standard, with ladder and platform; counterweight, suspension rods, base ring, racer, traversing rollers, dust guard, elevating band, and minor parts.

The following description refers particularly to the order in which the parts should be put together and to some especially necessary precautions, rather than to an enumeration of the details of the operation.

All machined parts, including all joints, keys, bolts, bolt holes, and working parts should be thoroughly cleaned, with fine emery paper if necessary, and oiled with good lubricating oil before being assembled.

Move the base ring to its position over the platform by means of skids and rollers. Place the thrust plates in position and lower the base ring by means of jacks until it rests on the platform with the bolts as nearly central in the holes as possible. None of the leveling screws should at first have a bearing on the thrust plates. Next, commencing at the highest point around the ring and noting that this point is down on clean concrete, or the proper distance below the crest of the parapet, level around each way and jack up the low points by means of the leveling screws.

A sensitive machinist's level and accurate steel straightedge should be used in leveling all parts.

The threads of the platform bolts should be carefully examined to see that they have not been burred in the operation of lowering and that they are free from rust. After they have been put in good order, thoroughly oil the threads of both bolts and nuts before screwing on the nuts. In screwing down the nuts on the platform bolts, take up on each a little at a time, so that no part of the base ring will be strained. After the base ring is properly leveled, and screwed down by the nuts of platform bolts, pour under it through the holes under the roller path a grouting of Portland cement.

After the grouting under the base ring has set firmly the leveling screws should be unscrewed slightly to prevent their being strained in firing.

Clean the lower roller path and the pintle surface with kerosene and emery cloth if necessary, after which place the roller and distance rings in position and run them around several times by hand to see that they work freely. If there is any undue bearing it must be remedied before proceeding.

The racer should now be cleaned, moved over the base ring, and lowered into position by jacks, care being taken to keep the racer level in lowering to prevent the pintle surface from jamming together. After the racer is in position put the dust guard in place to protect the traversing rollers from dirt while assembling the rest of the car-

riage. The pockets in the top of the racer, except one in rear, are to be filled with Portland cement, if this has not already been done.

Assemble together the chassis, transom, elevating-rack guides, racks, and elevating arm, and move the chassis over the racer, and, after cleaning and oiling the bearing parts, lower them into position and bolt securely in place.

For the purpose of assembling the counterweight, block up to the top of the well. Carefully place the bottom plate in position and level it. Lower the pieces of counterweight into position with the shears, the five complete disks first. The disks should be piled so that the holes are vertically above each other, and so placed that the suspension rods, after passing down through them, will engage the crosshead. Lower crosshead into position, engage it with suspension rods, and then put nuts on rods. Move top carriage into proper position, and engage crosshead with gun levers. The small counterweights should be piled later.

It is of importance that each suspension rod should bear half the weight; therefore the nuts should be carefully adjusted to bring this about, and the length of the suspension rods should be carefully measured so that one nut shall not be higher than the other.

The counterweight can now be lowered by jacks, bringing the tops of the levers to a convenient position for mounting the gun over the top of the parapet. The following method is, however, thought preferable: Jack the counterweight up until the levers are in the recoiled position, being careful to follow the counterweight with blocking. Mount the gun in place on the ends of the gun levers, bolt the gun-lever caps in place, and secure the muzzle of the gun to the crosshead by means of ropes.

Examine the stuffing boxes to see that they are properly packed, and screw the followers up as tight as one man can comfortably do it with a spanner wrench. Remove all the filling plugs and fill the cylinders with oil.

The elevating band can now be placed on the gun. To do this, remove the bolts and spread the ring, if necessary, until the opening will slip over the lug on the breech plate.

The band is in correct position when the centers of its journals are 80 inches from the centers of the trunnions of the gun, measured parallel to the axis of the gun, or when the set screws enter the tit holes in gun. This should be measured on both sides. After the band is properly placed screw up the bolts through the lugs and the set screws through the journals.

The elevating gear will ordinarily be found assembled when the carriage reaches its destination; if not, in assembling the gear the bushing should be taken from left cheek, and the wormwheel shaft should be put in from left side, care being exercised to put the parts on in the following order: Left pinion, thrust collar, wormwheel, friction clamp, balata cushion, adjusting nuts, and right pinion. A tooth should be found numbered on the *inside* of each pinion to correspond with spaces on the elevating racks, and the mechanism will be carefully assembled while these marked teeth and spaces are engaged. If no marks are found, level across the trunnions of the elevating racks, engage the pinions, and key them to the shaft without changing level of racks.

The racer clips, traversing gear, and other small parts can now be assembled.

After the carriage has been assembled and before letting the gun go in battery, the cylinders should be examined to see that they are filled with oil. After all of the bearing parts have been thoroughly cleaned and well lubricated the pawls should be examined to see that they are engaged properly in crosshead; the blocking under the counterweight should be removed, the pawls should be tripped and the gun allowed to rise to the firing position to see that everything is working properly. The pieces in the top layer of counterweight should be added gradually until the proper amount of counterweight necessary to raise the gun to the firing position without great shock on the counter-recoil stops has been determined, by allowing the gun to rise several times, each time with an increase of counterweight. *The retraction ropes should be detached after the gun is hauled down to the loading position and before it is allowed to rise again to the firing position.* The carriage should be traversed to its extreme positions against the azimuth stops, and the gun then hauled down to see that nothing will interfere with its recoil in these positions.

It may be stated generally that in assembling carriages no parts should be directly struck with a steel hammer, and that only copper drifts or copper or lead hammers should be used.

When two bearing surfaces are brought together, it is especially necessary that both parts should be absolutely clean, smooth, and well lubricated.

After the carriage has been completely assembled and the gun mounted the following important points should be noted, viz:

1. Traverse the carriage each way, and elevate and depress the gun to see that they work freely.
2. Examine and clean out all oil holes, noting that they have oil plugs.
3. See that there is not a hard bearing between the rimbases of the gun and gun levers, and that counterweight is equally borne upon each suspension rod.
4. See that the elevating arm and band are properly assembled, the clearances on each side being the same, and the arm not sprung or twisted. The elevating-rack trunnions should assemble, by the marks, at equal height.
5. See that the chassis rails and crosshead guides have not been burred.
6. See that the retracting ropes are properly adjusted, follow grooves on drum, and are not twisted.
7. See that the dust guard does not bear against the distance rings or racer.
8. Adjust the counterweight until gun rises as promptly as possible into battery, without striking the stops with violence, and noting that the counter-recoil buffers act efficiently.
9. See that the piston rods are parallel to the tops of the chassis rails, and also to their inside edges.
10. See that the stops to limit the motion in azimuth and depression are properly placed for the particular emplacement.
11. See that the pawls engage simultaneously on each rack of the crosshead and that the tripping and safety-tripping devices function properly.

12. Set the elevation pointer by the use of a clinometer supported by a rest in the muzzle of the gun, dowl-pin it in position, and verify the graduation.

13. Orient the gun, add numbers to the degree marks in the azimuth circle, adjust azimuth pointer to indicate correct azimuth, and dowl-pin it in position. Muzzle at true south 0 degrees in azimuth, and numbers are placed around clockwise to include 359.

14. Adjust the sight standard, by means of the counter set screws, so that with the sight holder rigidly clamped in position an accurate telescope will sight on the same distant point that it will when placed in the trunnion sight bracket, or that is covered by the bore sights.

15. Note that the telescope sight at right trunnion or at sight holder points in the same horizontal plane when set at the same elevation, and that this elevation agrees with that given by the clinometer supported by a rest in the muzzle of the gun.

16. Traverse the carriage to its extreme positions against the azimuth stops, and then haul the gun down to see that nothing will interfere with its recoil in these positions.

If any leakage occurs from the hydraulic recoil system it should be immediately remedied, calling, if necessary, upon the district armament officer for the services of skilled labor.

The repacking of stuffing boxes may be done, when necessary, by trained enlisted men under the supervision of an officer, but will preferably be done by skilled labor.

Before removing a cylinder head containing a stuffing box, or drawing a piston rod through a stuffing box, the pressure of the packing on the rod should be released by unscrewing the follower several turns.

The vulcanized-fiber or copper gaskets between cylinders and their heads should be in good condition, and consequently should be replaced whenever necessary in order to prevent leakage.

Recoil cylinders should be emptied at least every three months and thoroughly cleaned every six months.

CARE OF THE CARRIAGE—GENERAL INSTRUCTIONS.

Carriages should be traversed from time to time throughout their entire allowed movement.

The habitual position of guns on disappearing carriages is "from battery," but at intervals the gun should be allowed to rise to the firing position and be elevated and depressed within the limits of the stops.

It is especially required that all parts of carriages be kept free from rust *at all times*. If this be allowed to accumulate, its removal from all bearing parts, and especially piston rods, requires particular attention in order that clearances shall not be unduly increased. The use of sandpaper for this purpose is forbidden, and emery cloth No. 1, being coarse enough for any ordinary rusting, should be used, the rust being softened, if necessary, by kerosene.

The retracting wire ropes should at all times be kept well oiled with raw linseed oil.

CLEANING RECOIL CYLINDERS.—For this cleaning a plumber's hand force pump will be supplied to each coast artillery post, with about 10 feet of suction hose and 15 feet of discharge tube.

It will be noted that in no case will it be necessary to remove the packing from a stuffing box to clean the cylinders.

In cleaning, the following order of operations may be followed:

(a) Run gun into battery and remove oil from hydraulic recoil system.

(b) Retract gun until pistons are in the middle of the cylinders; then slack away until the pawls engage in the ratched teeth on the crosshead; observe that the pawls are properly engaged in the ratchet teeth, and that the pistons are not under the filing holes.

(c) Remove the piston-rod brackets from the rear ends of the chassis rails. Take off the two nuts on the front end of each piston rod, remove the rear cylinder head from each cylinder, and carefully remove the rods rearward out of the cylinders. Before removing any part it should be marked so as to insure its being reassembled in its correct position.

(d) Thoroughly clean each cylinder from both ends with kerosene oil, forced in with a hand pump, then wipe dry with clean cotton waste. Clean the piston rods and stuffing boxes. The equalizing and connecting pipes should be thoroughly cleaned by forcing kerosene oil into them with the pump, permitting it to run out through the emptying hole. The throttling-valve yoke should be unscrewed from the body and the pipes communicating with the throttling valve thoroughly cleaned.

(e) After the removal or evaporation of all kerosene oil, reassemble the parts and refill the cylinders with hydroline oil.

REMOVING PACKING FROM STUFFING BOXES (USING NEW EXTRACTOR FURNISHED BY THE ORDNANCE DEPARTMENT).—Close the extractor around the piston rod and insert the locking pin. Turn the extractor to the left, with pressure on the packing, until the needles are firmly engaged in the packing. Draw the packing out, turning slowly to the left. In the case of a box with interior thread, if the ring is tight it should be unscrewed and not stripped out by the thread, because, unless unscrewed, it would catch upon and be injured by the thread.

Extractor bars are provided to be used for starting the packing from its seat by inserting the toes of the bars in the rack teeth and prying over the edge of the box, being careful not to injure the thread.

REPACKING STUFFING BOXES.—Examine the old packing and discard all unfit for use. If any of the old packing is used it should be put in after the new.

To repack, put on the piston rod one ring of Garlock's "waterproof hydraulic" packing, 0.75 inch square, and force it well to the bottom of the stuffing box by a wooden stick and mallet. Treat each layer of packing in a similar manner, being careful to break the joints, until six rings of packing have been inserted. Place the halves of the gland on the follower, enter them together in the box, and screw up the follower, being careful to note that the halves of the gland do not bind on the screw threads.

No more force should be used on the spanner wrench than that of two men, and generally that of one man is sufficient. The addition of a pipe to the end of the spanner wrench should not be permitted.

When the box is properly filled and the follower tightened, there should not be more than 1 inch of space between the flange of the follower and the piece into which the follower is screwed. The fol-

lower should be tightened from time to time. If the follower is screwed into the stuffing box too tightly an unnecessary amount of friction will be produced on the piston rod. When the follower is screwed in until the flange strikes the box, another ring of packing should be inserted.

It is to be expected that a slight amount of oil will soak through and drip from boxes of carriages when not in use. Also when tightening the followers a slight amount of oil will squeeze out of the saturated packing. This oil should be caught and not allowed to render the carriage unsightly.

FILLING RECOIL CYLINDERS.—Fill the cylinders with oil, removing for this purpose the two plugs, one in each cylinder. Pour clean neutral oil of specific gravity about 0.85 (such as the "hydrolin" now issued to the service) into the hole in one cylinder until it flows out of the hole in the other. Allow any air that may be present to escape, then pour in more oil, until the system is filled to the level of the filling holes. About 15.5 gallons are required.

The cylinders will then be not full, but as nearly full as they are intended to be. The filling holes are intentionally placed below the highest point of the cylinders in order to leave above their level a void (or air space) equal to the volume of the counter-recoil buffer plus a few cubic inches to allow for expansion of the oil when heated by the weather or otherwise.

SERVICE CONDITION (LUBRICATION, ETC.).—When the carriage is to be kept in readiness for service, and is in daily or frequent use, all bearing parts must be kept thoroughly cleaned and lubricated. Especial attention should be given to the lubricating of gun trunnions, rollers, pintle surfaces, shaft axle bearings, and sliding surfaces; gun-lever axle bearings, crosshead pins, elevating rack, elevating-band trunnions, crosshead guides, and the elevating, traversing, tripping, and retracting mechanisms, including the teeth of all gears.

The above parts should be lubricated at frequent intervals whether the carriage is maneuvered or not. When carriages are in use for daily drills a thorough lubrication twice each week should be sufficient for all but the most severely used parts.

Proper lubrication and cleaning of the traversing rollers and their paths are essential to free working of the carriage. The dust guard may be removed to oil the traversing rollers, or to clean them, or the paths, or for other purposes.

Four oil holes are provided in the racer for oiling the pintle bearing; these holes are closed with screw plugs. *When oiling the pintle through these holes the carriage must be traversed in order to distribute the oil throughout the whole circumference.*

It will occasionally be necessary to examine all ball and roller bearings to see that the dust guards are in proper place and that the rollers themselves are clean. If they be found dirty, they may be flushed with kerosene oil; but care must be taken to fill the bearings with **Engine Oil No. 1** after the kerosene has drained away. If the rollers have rusted, the bearing must be taken out, the rollers cleaned, and the bearing reinserted.

CONDITION "IN ORDINARY" (NOT READY FOR IMMEDIATE SERVICE).—If the carriages are not in daily use, all bright and bearing parts should be covered with light slushing oil.

This oil can be applied by means of paint brushes, known as sash tools No. 6, issued for the purpose. Except in very cold weather, it can be applied in a thin uniform coat by using the brush as when painting. In cold weather it should be applied by stippling, i. e., by lightly tapping the surface with the brush held perpendicular to it. This oil can be readily removed by the use of burlap or waste dipped in kerosene oil.

Engine Oil No. 1 *only will be used for lubricating all parts of breech mechanisms of seacoast guns.* When guns are to remain unused for a short interval, all parts of the breech mechanisms will be covered with a thick coating of petrolatum; when guns are to remain unused for long intervals, a mixture of 75 per cent of petrolatum and 25 per cent of resin will be applied. *But these substances must be thoroughly removed before firing.*

Experience has indicated that the oil should not be removed from the recoil cylinders when carriages are to remain unused for a considerable period, as the walls of the cylinders soon become dry and then rust.

OIL HOLES.—Oil holes, where provided, must be cleaned out frequently to keep them free from sand and grit, and will habitually be kept closed by the screw plug provided, except when in the act of oiling.

Before oiling at any hole, wipe off carefully any dirt or grit near the opening that might be carried down into the bearing by the oil.

COMPRESSION GREASE CUPS.—Where compression grease cups are provided, similar precautions against dirt or grit must be observed. In filling these cups, do not fill the cup completely, but fill only to the bottom of the bevel at the top of the cup; if too full, the leather packing will not act as effectively. In putting on the cap, see that the leather-packed follower enters the cup without being caught, cut, or bent by the edge of the cup or otherwise. Screw the cap down on the cup, using a wrench, if necessary, to secure sufficient power, until the spring rod projects about $\frac{1}{4}$ inch above the top of the cap. Later, when the spring has recovered and has moved the follower forward, forcing the grease through the tube into the bearings, which will be indicated by the spring rod being pulled into the cap until its nut touches or nearly touches the cap, it will again be necessary to screw up the cap on the cup until the spring is again compressed. When the cap is screwed nearly home and the spring rod does not project it is an indication that the cup should be refilled.

OILS, GREASE, ETC.—The Vacuum Oil Company's No. 4 $\frac{1}{2}$ lubricant is issued for use in the compression grease cups; it will not be used for lubricating any other parts, nor will any other oil be used in its place.

Engine Oil No. 1 should be used to lubricate all bearings not provided with compression grease cups.

Kerosene oil is used by the Ordnance Department for cleaning purposes only.

A special grade of neutral oil called "hydroline," having a specific gravity of about 0.85, is furnished for filling the recoil cylinders, and a barrel of this oil should be kept on hand to replace leakage.

Tables of supplies for the above purposes are published from time to time by the Ordnance Department.

The different kinds of oil, etc., will be kept in receptacles plainly marked with their contents, and the soldiers should be carefully

instructed in the use of the several kinds of oil, grease, etc., and should be taught to distinguish one from another.

Oils must be always kept in closed receptacles to prevent contamination by water, dirt, etc.

Oil which has been used for any purpose must never be used again without being filtered or carefully strained. It is recommended that even then it be kept in receptacles, plainly marked, apart from the new unused oils.

PAINTING, ETC.—For further information regarding paints, oils, cleaning materials, and methods of using them, see Ordnance Department Pamphlet Form 1869. Annual allowances will also be found in this pamphlet.

LIST OF ARTICLES PACKED IN THE ARMAMENT CHEST FOR 8-INCH GUNS, MODELS OF 1888 MI AND MII, AND 8-INCH DISAPPEARING CARRIAGE, L. F., MODEL OF 1896.

NOTE.—All articles marked * are carried loose in the chest.

For gun:

- 1 bar screw driver for breech-plate screws.
- 1 bar screw driver for hinge-pin oil hole, breechblock oil hole, rotating handle and sight, and lock-plate screws.
- 1 bar screw driver for tray-back latch catch, breech-plate oil hole, spring-bolt shoe, tray-latch catch, and tray-lock screws.
- 1 bar screw driver for securing latch pivot, bronze bushing (for guns having steel breech plates), translating stud, and vent-cover pivot screws.
- 1 obturator-nut wrench.
- 1 obturator-nut clamp screw wrench.
- 1 metal scraper (for removing paint, etc.).
- 1 ring for lifting breech plate.
- 1 quire emery cloth, No. 00.
- 3 wagon sponges.
- *2 pounds copper wire, No. 12.
- *2 pounds copper wire, No. 16.
- *10 pounds cotton waste.
- *4 balls twine, assorted.
- *1 extension-pipe handle (used with some guns).
- 1 pin punch.
- 1 tit wrench for obturator spindle.
- 1 pressure-plug wrench.
- 1 tool for unscrewing housing of crank catch.
- 1 bronze drift (large).
- 1 bronze drift (small).
- 1 gunner's punch for vent.
- 1 gunner's drill.
- *1 box for firing mechanism.
- 3 brushes, cleaning, for primer seat (in firing-mechanism box).
- 1 cleaning reamer, for primer seat (in firing-mechanism box).
- *1 gunner's pouch.
- *1 pair gunner's sleeves.
- *1 gunner's lanyard.
- 1 file, flat, dead smooth, 8-inch.
- 1 file, round, second cut, 8-inch.
- 1 file, half round, smooth, 8-inch.
- 1 file, 3-cornered, 8-inch.
- 3 files, pillar No. 6, 6-inch.
- 3 files, 3-cornered, No. 4, 6-inch.
- 3 files, half round, smooth, 8-inch.
- 3 files, round, smooth, 8-inch.
- 1 copper hammer.
- 1 boiler-maker's hammer.
- 1 hand mallet.
- *1 long-handled mallet.
- 1 monkey wrench, 12-inch.
- 1 monkey wrench, 15-inch.
- 1 pair cutting pliers, 7-inch.

For carriage:

- *1 oiler, locomotive, 1-quart.
- 2 oilers, $\frac{1}{2}$ -pint.
- 2 wrenches, for piston-rod nuts.
- 1 spanner wrench, for stuffing boxes.
- 1 wrench, for cylinder heads and filling plugs.
- 1 double wrench, for $\frac{1}{2}$ and $\frac{3}{4}$ inch nuts.
- 1 double wrench, for 1-inch and $1\frac{1}{4}$ -inch nuts.
- 1 single wrench, for $1\frac{1}{2}$ -inch nuts.
- 1 single wrench, for $1\frac{3}{4}$ -inch nuts.
- 1 extractor, for gun-leveler and suspension-rod pins.
- 1 screw driver, steel.
- 1 screw driver, commercial, 5-inch blade.
- 2 counterweight hooks.
- 2 cylinder-head extractors.

The following articles, being too large, are not to be kept in the chest:

- 2 pinch bars.
- 2 water buckets, indurater fiber.

LIST OF IMPLEMENTS FURNISHED FOR 8-INCH GUN, MODELS OF 1888 MI AND MII.

- 1 rammer and staff.
- 1 rammer and staff, short.
- 1 sponge and staff, bore.
- 1 sponge and staff, chamber.
- 1 sponge and rammer prop.
- 1 breech cover.
- 1 combined tompon and muzzle cover.
- 1 sponge cover, bore.
- 1 sponge cover, chamber.
- 1 slush brush with handles to connect with special sponge staff.
- 1 steel scraper and socket to fit special sponge staff.
- 1 special sponge staff for slush brush and steel scraper.

LIST OF EQUIPMENT SUPPLIED FOR 8-INCH GUN, MODELS OF 1888 MI AND MII, DIS-
APPEARING CARRIAGE, L. F., MODEL OF 1896.

- 2 paint pots, 1-gallon.
- 1 sieve for paints and oils.
- 2 brushes, wall, 4-inch.
- 3 sash tools, No. 6.
- 3 brushes, paint, 6/0.
- 2 dusters, painter's, No. 2.

MATERIAL FOR CLEANING AND PRESERVATION OF 8-INCH GUN, MODELS OF 1888 MI
AND MII, DISAPPEARING CARRIAGE, L. F., MODEL OF 1896.

[All expandable.]

- 2 gallons superior graphite paint, No. 57, for guns only.
- 12 gallons superior graphite paint, No. 38, for carriages only.
- 3 gallons linseed oil, boiled.
- 62 pounds light slushing oil for bores of guns, etc.
- 2 gallons synovial oil, and
- 8 pounds grease forcer lubricant, No. 4 $\frac{1}{2}$, for lubricating carriages.
- 20 gallons hydroline for filling cylinders.
- 10 gallons kerosene oil.
- 25 pounds cotton waste.
- 30 yards burlap.
- 4 packing needles.
- 2 pounds flax twine.
- 18 rings Garlock waterproof hydraulic packing, 0.75 square and 3 inches inside diameter, for piston rods.
- 3 rings Garlock waterproof hydraulic packing, 0.25 square and 1 inch inside diameter, for throttling valve.
- 1 set gaskets for carriage.
- 1 quire emery cloth, No. 1.
- 1 quire emery cloth, No. 00.

Weights of the principal parts of the 8-inch disappearing carriage, L. F., model of 1896.

Name.	Weight.
	<i>Pounds.</i>
Base ring.....	10,200
Racer.....	7,600
Top carriage.....	4,950
Chassis, each 5,000 pounds.....	10,000
Traverse rings, complete.....	1,300
Transom.....	1,900
Crosshead.....	2,100
Elevating arm.....	1,100
Gun levers, each 2,100 pounds.....	4,200
Gun-lever axles.....	1,200
Elevating racks, each 280 pounds.....	520
Elevating-rack guides, each 140 pounds.....	280
Traverse rollers, each 64 pounds.....	1,536
Set recoil rollers, one side 408 pounds.....	816
Suspension rods, each 250 pounds.....	500
Bottom plate.....	1,238
Two ropes.....	67
Sight standard.....	96
Worm-wheel casing.....	210
Piston rods, each 310 pounds.....	620
Implement box and contents.....	312
Rear-sight platform.....	250
Lead weight.....	37,800
Total estimated weight of the carriage.....	91,730
Estimated weight of three ammunition trucks.....	1,293
Total weight.....	180,818

The following list of parts is based upon recent revisions of the drawings. Carriages not yet modified to conform thereto may have parts not conforming to this list:

List of parts.

Parts in parentheses () are composite.

Designations of columns: *a*, material; *b*, number; *c*, side of square, longer side if rectangular, outside diameter if round, diameter of bolts or studs for nuts; *d*, shorter side if rectangular, or diameter of hole; *e*, length, or thickness of washers, nuts, etc.

Name of part.	Location.	<i>a.</i>	<i>b.</i>	<i>c.</i>	<i>d.</i>	<i>e.</i>	Remarks.
Adjusting nut....	Worm-wheel shaft...	Steel.....	2	2.75	.....	1.75	10 threads per inch.
Arm.....	Shot tongs.....	...do.....	7	.....	.....	.....	2 parts, right and left, riveted together, straight shank.
Do.....	...do.....	...do.....	7	.....	.....	.....	2 parts, right and left, riveted together, bent shaft.
Azimuth circle....	On base ring.....	Brass.....	1	.....	.....	.....	On 6 sections.
Azimuth - circle dust guard.	On racer.....	...do.....	1	.....	.....	.....
Azimuth pointer ..	...do.....	...do.....	1	.....	.....	.....	For carriages 1 to 35, inclusive, a single piece. (For carriages 36, 37, 38 consists of azimuth - pointer body, screw, collar, pin, nut, hinge pin, lid, slide, index, countersunk screws.)
Azimuth - pointer body.	...do.....	Bronze.....	1	.....	.....	.....	For carriages 36, 37, 38.
Balata cushion....	Buffer bracket and cap.	Balata.....	12	.....	.....	.....
Ball-bearing cover.	Ball-thrust bearing.	...do.....	1	.....	.....	.....
(Ball thrust bearing.)	In worm-wheel casing.	.....	1	.....	.....	.....	Consisting of balls, ball washers, ball-bearing cover, and round-head screws.

List of parts—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
Ball.....	Ball thrust bearing..	Steel.....	18	0.5			Upper and lower halves.
Ball washer.....	do.....	Hardened steel.	2				
Base ring.....	On platform.....	Cast iron, No. 2.	2				
Bevel gear.....	Top end of traversing pinion shaft.	Bronze.....	1				30 teeth.
Bevel pinion.....	End of traversing intermediate shaft.	Steel.....	1				15 teeth.
Binding screws....	Sight-standard cap..	Wrought iron	2				
Bolt, countersunk..	Top-carriage platform to braces.	do.....	3	.75		1.75	
Bolt, hexagon head.	Buffer brackets to chassis.	do.....	4	1.75		9.5	
Do.....	do.....	do.....	8	1.25		9	
Do.....	Elevating band.....	do.....	2	1.75		14	
Do.....	Sight-standard ladder brace to right chassis.	do.....	2	1		4	
Bolt, tap (hexagon head).	Chassis to racer.....	do.....	42	1.25		4	
Do.....	Clamp to retraction-rope drum.	do.....	4	.5		2	
Do.....	Distance-ring joints.	do.....	20	.75		2.5	
Do.....	Dust-guard joints..	do.....	48	.5		.625	
Do.....	Dust guard to racer.	do.....	48	.5		1	
Do.....	Elevating-shaft bracket.	do.....	2	1		2.5	
Bolt, tap.....	Elevating coupling to top carriage.	do.....	2	.75		1.75	
Do.....	Elevation pointer to bracket.	do.....	2	.5		1.5	2 nuts, 2 washers.
Do.....	Elevation-pointer bracket to chassis.	do.....	3	.5		1.5	
Do.....	Floor plates to chassis.	do.....	10	.75		1.75	For carriages 25 to 38, inclusive.
Do.....	do.....	do.....	9	1		2	For carriages 1 to 24, inclusive.
Do.....	do.....	do.....	2	.75		1.75	Do.
Do.....	Handles on right gun lever.	do.....	2	.75		1.5	
Do.....	Lanyard cam to elevating arm.	do.....	2	.375		.75	
Do.....	Lanyard filling piece to elevating arm.	do.....	2	.5		1.25	
Do.....	Case to lanyard filling piece.	do.....	2	.5		1.5	With nuts
Do.....	Piston-rod brackets to chassis.	do.....	4	1		3.25	
Do.....	Pit-ladder brace to chassis.	do.....	2	.75		1.5	
Do.....	Pit ladder to racer..	do.....	2	.75		1.5	
Do.....	Brace to pit ladder..	do.....	2	.75		1.875	
Do.....	Filler pieces to chassis.	do.....	4	.625		1.5	
Do.....	Racer clip to racer..	do.....	4	1.25		3.75	
Do.....	Retraction-rope guard to buffer bracket.	do.....	4	.5		1	For carriages after 26
Do.....	Retraction-rope guard to chassis.	do.....	6	.75		1.5	For carriages 1 to 26, inclusive.
Do.....	Retraction-rope guard to transom.	do.....	4	.75		1.5	For carriages after 26.
Do.....	Retraction-shaft bracket to transom.	do.....	4	1.25		2.75	
Do.....	Sight-standard cap..	do.....	8	.5		1.5	
Do.....	Felt strip to dust guard.	do.....	48	.5		.75	
Do.....	Sight-standard platform brace to chassis.	Wrought iron	4	1		2	
Do.....	Steps to chassis.....	do.....	4	1		2.25	
Do.....	Suspension-rod nut..	do.....	8	.75		3.5	
Do.....	Throttling bars to recoil cylinders.	do.....	28	.75		2.55	
Do.....	Throttling valve to top carriage.	do.....	2	.75		1.75	
Do.....	Top-carriage platform and ladder to top carriage.	do.....	4	.75		1.5	
Do.....	Transom to chassis..	do.....	12	1.25		3.25	

List of parts—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
Bolt, tap.....	Traversing-gear bracket to racer.	Wrought iron.	3	1	.....	2.75	
Do.....	Tripping-lever rest to floor plate.	.....do.....	4	.75	.....	1	
Do.....	Worm-wheel casing to racer.	.....do.....	4	1.25	.....	3.25	
(Buffer and bracket, recoil buffer.)	On chassis.....	.....	.....	.....	.....	.....	Consisting of buffer bracket, balata cushions, plates, buffer cap, and bolts.
Buffer body.....	Elevating-rack buffer.	Wrought iron.	2	.....	.....	.....
Buffer bracket.....	Buffer and bracket..	Cast steel, No. 1	2	.....	.....	.....	1 right, 1 left.
Buffer cap.....	.....do.....	Wrought iron	2	.....	.....	.....
Buffer-cap bolt.....	.....do.....	.....do.....	4	.75	.....	11.25	
Buffer cap.....	Rear cylinder heads, top carriage.	Special bronze.	2	.....	.....	.....
Buffer piston.....	Piston rod.	Steel	2	.....	.....	.....
Buffer spring.....	Elevating-rack buffer.	Spring steel..	2	.....	.....	.....	8 coils.
Buffer-spring bolt.....	.....do.....	Wrought iron	2	.....	.....	.....
Bushing.....	Crosshead pawl.	Bronze	4	2.25	2	.725	
Do.....	Elevating-shaft bracket.	.....do.....	1	2.5	2	3.5	Driven in.
Do.....	.....do.....	.....do.....	1	2.5	1.95	3.5	Do.
Do.....	Left chassis.....	.....do.....	2	2.5	2	5	
Do.....	.....do.....	.....do.....	1	2.125	1.625	5	
Do.....	.....do.....	.....do.....	1	3.25	2.4	5	With shoulder.
Do.....	.....do.....	.....do.....	1	2.6	2.1	5	
Do.....	Lower end of elevating arm.	.....do.....	2	5.5	4.5	3	
Do.....	Lower end of gun lever.	Special bronze	2	7	6	5.25	
Do.....	Pawl lever.....	Bronze	2	2.25	2	.6	Forced in.
Do.....	Pawl safety latch.	.....do.....	1	1.1	.9	2.7	Do.
Do.....	Retraction-rope pulley.	Forged steel..	2	2.5	1.8125	3	
Do.....	Right chassis.....	Bronze	3	2.5	2	5	
Do.....	.....do.....	.....do.....	1	2.125	1.75	5	
Do.....	.....do.....	.....do.....	1	3	2.5	5	
Do.....	.....do.....	.....do.....	1	2.9	2.4	5	
Do.....	.....do.....	.....do.....	1	2.45	1.95	5	
Do.....	Racer, traversing-shaft bearing	.....do.....	1	3	2.5	3.5	
Do.....	Roller frame, side pieces.	.....do.....	48	1.25	1	1	
Do.....	Top carriage, gun-lever axle bearing.	Special bronze	2	9.25	8 + .01	6 - .02	4 halves.
Do.....	Traversing-gear bracket.	Bronze	1	3	2.5	3.5	
Do.....	Tripping-shaft bracket.	.....do.....	1	2.125	1.75	5	Forced in.
Do.....	.....do.....	.....do.....	1	2.125	1.025	5	Do.
Do.....	Upper end of gun lever.	Special bronze	2	11.25	10 + .02	6 - .025	4 halves.
Do.....	Worm-wheel casing.	Bronze	1	2.5	2	2.25	
Cap square.....	Upper ends of gun lever over gun trunnions.	Forged steel, No. 3.	2	.....	.....	.....
Do.....	Top carriage over gun-lever axle.	Cast steel, No. 1	2	.....	.....	.....
Chassis.....	On racer.....	Cast iron, No. 2.	2	.....	.....	.....	Right and left.
Clamp.....	Retraction-rope drum.	Steel	2	.....	.....	.....	1 right, 1 left.
Collar.....	Retraction-drum shaft.	.....do.....	1	5	2.5	1.5	
Do.....	Screw for azimuth pointer.	Bronze	1	.....	.....	.....	For carriages 36, 37, 38.
Do.....	Handwheel shaft.	Steel	1	3.5	1.9	1.25	
Do.....	Traversing-crank shaft.	.....do.....	1	3.5	2	1.25	
(Counter-recoil buffer.)	Recoil cylinder.....	.....	2	.....	.....	.....	Consists of buffer, piston, buffer cup, and pins.
Counterweight.....	Suspended from crosshead.	Cast lead.....	26	.....	.....	.....	Top group.
Do.....	.....do.....	.....do.....	4	.....	.....	.....	2d layer.
Do.....	.....do.....	.....do.....	1	.....	.....	.....	3d layer.

List of parts—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
Counterweight.....	Suspended from crosshead.	Cast lead.....	5	.....	.....	.....	4th to 8th layers, inclusive, all similar.
Counterweight bottom plate.	.....do.....	Cast iron, No. 2.	1	.....	.....	.....
Counterweight handle.	In staples cast in counterweight.	Wrought iron	26	.....	.....	.....
Counterweight hook.	With carriage.....	Steel.....	2	.....	.....	.....
Coupling.....	Retraction - crank shaft.	.....do.....	1	3.75	.....	5	
Do.....	Emptying coupling.	Bronze.....	3	.....	.....	.....
Do.....	Throttling valve.	.....do.....	3	.....	.....	.....
Crosshead.....	Connecting counterweight to gun levers.	Cast steel, No. 1.	1	.....	.....	.....
Crosshead liner....	In crosshead at base of gun levers.	Tobin bronze.	16	.....	.....	.....
Crosshead pawl....	On pawl fulcrum.	Steel.....	2	.....	.....	.....	1 right, 1 left.
Crosshead - pawl spring.	Between pawl lever and crosshead pawl.	Spring steel..	2	.....	.....	.....	21 coils.
Crosshead - pawl spring pin.	Crosshead pawl....	Steel.....	2	.....	.....	.....
Do.....	Pawl lever.....	.....do.....	2	.....	.....	.....
Crosshead - pawl stop.	.....do.....	.....do.....	2	.....	.....	.....	1 right, 1 left.
Crosshead - pawl washers.	Pawl fulcrum.....	Bronze.....	6	4	2	.....	Two 0.12" thick.
Crosshead notch number plate.	Front of crossheads.	.....do.....	2	.....	.....	28.25	Four 0.05" thick.
Cup leather.....	Grease-cup plunger.	Leather.....	6	.....	.....	.....
Cylinder-head extractor.	With carriage.....	Steel.....	2	.....	.....	.....
Distance ring.....	At traversing rollers, inner ends.	Wrought iron	1	.....	.....	.....	In halves.
Do.....	At traversing rollers, outer ends.	.....do.....	1	.....	.....	.....	Do.
Door.....	At floor plate.....	Steel plate....	1	.....	.....	.....
Double wrench.....	With carriage.....	Steel.....	1	.....	.....	.....	For 1" and 1 1/2" ngs.
Do.....	.....do.....	.....do.....	1	.....	.....	.....	For 1" and 1 1/2" nuts.
Dowel pin.....	Azimuth pointer.....	.....do.....	2	.125	.125	.....	For carriages 1 to 35, inclusive.
Do.....	.....do.....	.....do.....	2	1/8	.....	.....	For carriages 36, 37, 38.
Do.....	Elevating-sh bracket to transom.	.....do.....	2	.5	.....	.....
Do.....	Elevating pointers.	.....do.....	4	.25	.....	.5	
Drainpipe.....	Pocket of racer under worm-wheel casing.	.....do.....	.....	.....	.....	3.5	
Dust guard.....	For traversing rollers.	Steel.....	1	.....	.....	.....	6 sections.
Dust guard, felt....	Inside steel dust guard at bottom.	.....do.....	1	.....	.....	.....
Dust-guard body...	Roller-bearing dust guards.	Steel.....	2	.....	.....	.....	1 with 0.255" bore, 1 with 2.3" bore.
Elevating arm.....	Connecting breech of gun to elevating racks.	Cast steel, No. 1.	1	.....	.....	.....
Elevating-arm box	Upper end of elevating arm.	Bronze.....	2	.....	.....	.....	4 halves.
Elevating-arm cap.	.....do.....	Steel.....	2	.....	.....	.....
Elevating band.....	On breech of gun...	Cast steel, No. 1.	1	.....	.....	.....
Elevating-band set screw.	Elevating-band trunnions.	Steel.....	2	.....	.....	.....
Elevating direction plates.	On sides of chassis.	Bronze.....	2	.....	.....	.....	1 right, 1 left.
Elevating hand-wheel.	Ends of handwheel shaft.	Cast and wrought iron.	2	.....	.....	.....
Elevating pinion..	On worm-wheel shaft.	Bronze.....	2	.....	.....	.....	20 teeth; 1 2.5" bore, 1 3.05" bore.
Elevating rack.....	On guides on chassis.	Cast steel, No. 1.	2	.....	.....	.....	1 right, 1 left.

List of parts—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
(Elevating-rack buffer.)	Below elevating racks.	2	Consisting of buffer body with end-washer buffer.
Elevating-rack guide.	Chassis.....	Bronze.....	2	.....	.....	.....
Elevating-rack guide screw.	Elevating-rack guide and chassis.	Steel.....	20	1	.....	2.9
Elevating-rack stop.	On inside of chassis.	do.....	2	.....	.....	.....
Elevating-shaft bracket.	On transom.....	Cast iron.....	1	.....	.....	.....
Elevation disk.....	End of worm wheel shaft.	do.....	1	Consisting of emptying-coupling body, washer, fiber packings, and emptying plug.
Elevation pointer..	Outside of bracket at elevation disk.	Bronze.....	1	.....	.....	.....
Elevation pointer bracket.	To chassis.....	do.....	1	.....	.....	.....
(Emptying coupling.)	Equalizing pipe.....	.....	1	.....	.....	.....
Emptying - coupling body.	Emptying coupling.	Bronze.....	1	.....	.....	.....
Emptying plug.....	do.....	Steel.....	1	In 5 parts.
End piece.....	Roller frame.....	do.....	4	.....	.....	.....
Equalizing pipe...	Top carriage connecting recoil cylinders.	Copper.....	1	.....	.....	.....
Equalizing-pipe collar.	Ends of equalizing pipe.	do.....	10	Brased on pipe.
Equalizing pipe...	Connecting equalizing pipe to recoil cylinders.	Bronze.....	4	Free.
Equalizing-pipe ring.	Ends of equalizing pipe.	Steel.....	10	.....	.....	.....
Equalizing-pipe strap.	Securing equalizing pipe to top carriage.	Wrought iron.	2	.....	.....	.....
Extractor.....	With carriage.....	Steel.....	1	For gun lever and suspension-rod pins.
Eyebolt.....	In caps for gun levers.	Wrought iron.	2	1	For carriages 1 to 26, inclusive.
Do.....	In cap-square for top carriage.	do.....	2	1	.....	.....
Do.....	Worm wheel and using upper half.	do.....	1	.5	.....	.....
Eye piece.....	Shot tongs.....	Steel.....	7	.....	.....	.....
Eye piece pin.....	do.....	do.....	7	.75	.....	3
Filler piece.....	Between retraction-shaft bracket and transom.	Wrought iron	1	Do.
Do.....	Between chassis and door.	Steel.....	1	3.5	.75	20	
Do.....	Between retraction-shaft bracket and chassis.	Cast iron.....	1	.....	.....	.....
Filling plug.....	On top of recoil cylinders.	Bronze.....	12	6" reserve.
Filling instruction plate.	Top of recoil cylinder	do.....	2	4	4 halves. Do.
Floor plate.....	On racer end chassis.	Steel.....	2	.....	.....	.....
Follower.....	Throttling valves...	Bronze.....	1	.....	.....	.....
Do.....	Grease cup.....	do.....	6	.....	.....	.....
Do.....	Front stuffing box, top carriage.	do.....	2	.....	.....	.....
Do.....	Rear stuffing box, top carriage.	do.....	2	White metal.
Friction clamp...	Worm wheel shaft...	Cast steel...	1	.....	.....	.....
Front stuffing box.	Front end of recoil cylinder.	Bronze.....	2	.....	.....	.....
Gland.....	Front stuffing box...	do.....	2	.....	.....	.....
Do.....	Rear stuffing box...	do.....	2	.....	.....	.....
Do.....	Throttling valves...	do.....	1	White metal.
Graduation strip..	Around elevation disk.	White metal.	1	.....	.....	.....

List of parts—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
(Grease cup).....	Gun levers at gun trunnions.	.....	2	.....	.....	.....	Consisting of grease-cup body, follower, plunger and nut, cup-leather, washer, round-head screw, spring, and pin.
Do.....	Gun-lever axle.....	.....	2	.....	.....	.....	Do.
Do.....	Gun-lever pin.....	.....	2	.....	.....	.....	Do.
Grease-cup body.....	Grease cup.....	Bronze.....	6	.....	.....	.....
Grease-cup plunger.....	.....do.....	.....do.....	6	.....	.....	.....
Gun lever.....	Carrying gun.....	C a s t steel, No. 1.	2	.....	.....	.....	1 right, 1 left.
Gun-lever axle.....	Uniting gun levers.....	Forged steel, No. 3.	1	.....	.....	.....
Gun-lever pin.....	Crosshead to gun levers.	.....do.....	2	.....	.....	.....
Handle.....	Upper part of right gun lever.	Wrought iron	1	.....	.....	.....
Handwheel shaft.....	Through chassis, elevating gear.	Steel.....	1	.....	.....	.....
Hinge.....	With lid for azimuth pointer.	Bronze.....	1	.....	.....	.....	For carriages 36, 37, 38.
Hook.....	Upper ends of gun levers.	Wrought iron	2	.....	.....	.....
Implement box.....	With carriage.....	Ash.....	1	.....	.....	.....
Index.....	Azimuth pointer.....	Bronze.....	1	.....	.....	.....	For carriages 36, 37, 38.
Key.....	Chassis to racer.....	Steel.....	4	2	1	10	
Do.....	Gun lever to gun-lever axle.	.....do.....	2	1.5	1	6	
Key, square.....	Bevel pinion and traversing intermediate shaft.	.....do.....	1	.5	.....	2.25	
Do.....	Elevating hand-wheel to hand-wheel shaft.	.....do.....	2	.5	.....	2.5	
Do.....	Elevating disk to wormwheel shaft.	.....do.....	1	.5	.....	2	
Do.....	Friction clamp to wormwheel shaft.	.....do.....	2	.6	.....	3.5	Removable.
Do.....	Miter gear to worm shaft.	.....do.....	1	.5	.....	2	
Do.....	Retraction crank shaft and coupling.	.....do.....	1	.5	.....	5	
Do.....	Retraction spur gear and drum shaft.	.....do.....	1	.4	.....	6.75	
Do.....	Retraction spur gear and right rope drum.	.....do.....	2	.5	.....	3	
Do.....	Retraction spur gear on spur-pinion shaft.	.....do.....	1	.5	.....	2.25	
Do.....	Sleeve to hub of elevation disk.	.....do.....	2	.5	.....	1.25	
Do.....	Traversing gear and traversing intermediate shaft.	.....do.....	1	.5	.....	2	
Do.....	Traversing pinion and traversing-pinion shaft.	.....do.....	1	.5	.....	3.25	
Do.....	Traversing pinion to traversing - crank shaft.	.....do.....	1	.5	.....	3.5	
Do.....	Traversing - pinion shaft and bevel gear.	.....do.....	1	.5	.....	2.5	
Do.....	Tripping lever and shaft.	.....do.....	2	.25	.....	3.5	
Key, square, with head.	Elevating pinion to worm-wheel shaft.	.....do.....	4	.6	.....	2.75	
Do.....	Left retraction-rope drum and drum shaft.	.....do.....	.....	.5	.....	4.5	
Do.....	Miter gear to hand-wheel shaft.	.....do.....	1	.5	.....	2	
Do.....	Pawl-lever crank and tripping shaft.	.....do.....	2	.5	.....	3	
Do.....	Ratchet wheel to retraction - c r a n k shaft.	.....do.....	1	.5	.....	2.75	

List of parts—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
Ladder	To chassis and racer.	Steel	1				
Lanyard cam	To elevating arm	Bronze	1				
Lanyard filling piece.	To elevating band	do	1				
Lanyard attachment case.	Lanyard filling piece	do	1				
Lanyard attachment case cover.	Lanyard attachment case	do	1				
Lanyard attachment pawl.	On pawl pin	Steel	1				
Lanyard attachment pawl spring.	Lanyard attachment case and pawl	do	1	0.3		1.1	Wire, 0.04" diameter.
Lanyard attachment pawl pin.	In lanyard attachment case	do	1	.25		1.35	
Lanyard attachment reel.	do	Bronze	1				
Lanyard attachment spring.	do	Steel	1				0.025 thick, 18' 6" long.
Lanyard attachment shaft.	do	do	1	.62			1 nut, 1.06 flats.
Lanyard guide	Near breech of gun	Bronze	1				
Lanyard extension	Lanyard attachment and guide	do	1				Italian hemp cord, 35' long.
Latch	Throttling valve	Bronze	1				
Leveling screw	In base ring	do	12	1.75		3.25	
Lid	Racer, over azimuth pointer	do	1				For carriages 36, 37, 38.
Link	Shot tongs	Steel	7				
Link pin	do	do	7				
Liner	Between top carriage and chassis	Bronze	2				
Miter gear	On handwheel and worm shafts	Steel	2				18 teeth; one 1.9" bore; one 2" bore.
Mossberg roller bearing.	Right chassis and retraction-shaft bracket		2				Consisting of parts not to be disassembled.
Do	Retraction-rope pulley		2				Do.
Do	Left chassis		1				Do.
Name plate	Right chassis	Bronze	1				No. 2.
Nut	Screw for azimuth pointer	do	1				For carriages 36, 37, 38.
Nut, hexagonal	Bolts, buffer bracket to chassis	Wrought iron	4	1.75		1.75	
Do	do	do	8	1.25		1.25	
Do	Bolts, elevating-band	do	2	1.75		1.75	
Do	Bolts, sight-standard ladder brace to right chassis	do	2	1		1	
Do	Bolts, top-carriage platform to brace	do	3	.75		.75	
Do	Buffer-cap bolts	do	4	.75		.75	
Do	Buffer-spring bolts	do	4	1		1	
Do	Elevating-rack buffer	do	2	1.25		1.25	
Do	Front ends, piston rods	do	4	2.5		2	
Do	Pawl fulcrum	do	2	1.5		1.5	
Do	Separator bolts	do	12	1		1	
Do	Sight-standard platform guard rail	do	8	1		1	Pipe thread.
Do	Studs, caps for gun levers	do	4	1.75		1.75	
Do	do	do	4	1.75		1	
Do	Studs, cap-squares for top carriage	do	4	1.5		1.5	
Do	Studs, elevating-arm caps	do	8	1		1	
Do	Studs, racer, for azimuth-pointer body	do	2	.5		.5	For carriages 36, 37, 38.
Do	Studs, rear cylinder heads	do	24	.75		.75	
Do	Top-carriage platform rail	do	4	.75		.75	
Oil can	With carriage	Brass	2				1/2 pint.

List of parts—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
Oil can with valve.	With carriage.	Brass.	1				1 quart.
Oil plugs, large.		do.	7	0.625		1	2 extra.
Oil plugs, small.		do.	83	.325		.75	20 extra.
							(Use one of these sizes of oil plugs wherever the space allows the use of oil plug for closing oil hole.)
Packing.	Emptying plug.	Flexible vulcanized fiber.	1				
Do.	Equalizing pipe and recoil cylinder.	do.	4				
Do.	Equalizing pipe, emptying coupling, and throttling valve.	do.	6				
Do.	Filling plug.	do.	6				
Do.	Front stuffing box, top carriage.	do.	2				
Do.	Rear stuffing box, top carriage.	do.	2				
Do.	Throttling valve.	Garlock waterproof.	1				5 rings, 1 in reserve.
Pawl fulcrum.	Front ends of chassis.	Steel.	2				
Pawl lever.	In crosshead pawl on pawl fulcrum.	Forged steel, No. 3.	2				Pin riveted in one on right side.
Pawl-lever crank.	On tripping shaft.	Steel.	2				1 bored 1.75" diam., 1 bored 1.7" diam.
Pawl-lever link.	Between pawl lever and pawl-lever link.	do.	2				
Pawl-lever link pin.	Pawl-lever link.	Bronze.	4	$\frac{1}{1004}$		2.1	
Pawl safety latch.	Pawl safety-latch fulcrum.	Steel.	1				
Pawl safety-latch fulcrum.	Right chassis.	do.	1				
Pawl safety-latch dog.	Crosshead.	do.	1				
Pawl safety-latch spring.	Between chassis and pawl safety latch.	Spring steel.	1				25 coils.
Pawl safety-latch spring pin.	Right chassis and pawl safety latch.	Steel.	2				
Pawl safety-latch stop.	Right chassis.	do.	1				
Pin.	Buffer piston and piston rod.	do.	2	.5		.499	Riveted.
Do.	Driven in retraction-rope loop.	do.	20				
Do.	Grease-cup plunger.	do.	1				
Do.	Lid and hinge for azimuth pointer.	do.	1	.375		9.75	For carriages 36, 37, 38.
Do.	Roller frame.	do.	4	1			
Do.	Separator bolt.	do.	12	.25			
Do.	Screw and collar for azimuth pointer.	Brass.	1	.125			For carriages 36, 37, 38.
Pinch bar.	With carriage.	Steel.	2				
Piston and rod.	Piston-rod bracket and recoil cylinders.	Forged steel, No. 3.	2				
Piston liners.	In pistons.	Bronze.	8				
Piston-liner pin.	In piston liners.	Steel.	16	.25		1	
Piston-rod bracket.	On top of chassis.	Cast steel, No. 1.	2				1 right, 1 left.
Plate.	Buffer and bracket.	Wrought iron.	10				
Plugs, filling.	Top recoil cylinders.	Bronze, No. 3.	4	.1		1.25	
Plugs, cylinder.	Recoil cylinders.	Bronze, No. 4.	6	1.625			
Plunger nut.	Grease-cup plunger.	Steel.	6	.625		.35	
Racer.	On traversing rollers.	Cast steel, No. 1.	1				
Racer clip.	On racer.	do.	2				
Ratchet wheel.	On retraction crank shaft.	Steel.	1				

List of parts—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
Ratchet-wheel pawl.	On ratchet-wheel pawl pin.	Steel.....	1				
Ratchet-wheel pawl pin.	On chassis.....	do.....	1				
Ratchet-wheel pawl stop.	do.....	do.....	1	.5		3	
Rear stuffing box..	Rear ends of recoil cylinders.	Cast steel.....	2				
Retraction and traversing crank.	Retraction and traversing crank shafts.	Forged steel..	2				Handles with brass sleeves.
Retraction crank shaft and pinion.	Through chassis.....	Forged steel, No. 2.	1				Part of shaft solid with pinion coupled to the other part, 12 teeth in pinion 1 right, 1 left.
Retraction direction plate.	On sides of chassis..	Bronze.....	2				
Retraction drum...	Through chassis.....	Forged steel, No. 3.	1				
Retraction rope....	From gun levers to retraction-rope drums.	Cast-steel wire.	2				
Retraction-rope drum.	Retraction-drum shaft.	Cast iron.....	2				1 right, 1 left, for carriages after 26.
Do.....	do.....	do.....	1				Right hand for carriages up to 26, inclusive.
Do.....	do.....	do.....	1				Left hand for carriages up to 26, inclusive.
Retraction-rope guard.	Transom and buffer and bracket	Sheet steel...	2				For carriages after 26.
Do.....	Inside of chassis.....	do.....	2				1 right, 1 left, for carriages up to 26, inclusive.
Retraction-rope loop	Buffer bracket.....	Cast iron.....	2				
Retraction-shaft bracket.	Transom and right chassis.	Cast steel, No. 1.	1				For carriages up to 26, inclusive.
Do.....	Transom.....	do.....	1				For carriages after 26.
Retraction-shaft handwheel.	For retraction-crank shaft.	Bronze.....	1				Steel handle, screwed on.
Retraction-spur gear.	On retraction-drum shaft.	Cast steel, No. 1.	1				60 teeth.
Do.....	Retraction-spur pinion shaft.	do.....	1				56 teeth.
Retraction-spur pinion.	Inside of right chassis.	Forged steel, No. 2.	1				12 teeth, solid, with shaft.
Rivet.....	Throttling-valve body and latch.	Brass.....	1	.05		2.05	
Roller.....	Roller frame.....	Forged steel, No. 3.	24				
(Roller-bearing dust guard.)	On chassis at retraction-drum shaft bearing.		2				Consisting of dust-guard body steel and felt washers and counter-sunk screws.
(Roller frame)....	On top of chassis.....		2				Consisting of rollers, side and end pieces, pins, stays, screws, and bushings.
Rope pulley axle..	Buffer bracket.....	Steel.....	2				
Rope stop.....	Retraction-rope drums.	Cast steel.....	2				1 right, 1 left, for carriages after 26.
Do.....	Left-hand retraction-rope drum.	do.....	1				For carriages 1 to 26, inclusive.
Do.....	Right-hand retraction-rope drum.	do.....	1				Do.
Screen.....	Sight-standard platform.	Wrought iron	1				
Screw.....	Azimuth pointer....	Bronze.....	1				For carriages 36, 37, 38.
Screw, countersunk	Azimuth circle.....	Brass.....	56	.25		.5	
Do.....	Azimuth-circle dust guard.	do.....	6	.25		.5	
Do.....	Bushings in gun lever for gun trunnion.	do.....	16	.5		1.25	

List of parts—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
Screw, countersunk	Crosshead liners.....	Brass.....	24	.625	.....	1	
Do.....	do.....	do.....	4	.625	.....	1.25	
Do.....	do.....	do.....	4	.625	.....	2.5	
Do.....	Direction plates.....	do.....	24	.25	.....	.6	
Do.....	Graduation strip on elevation disk.....	German silver.....	6	.312($\frac{1}{8}$)	.....	.5	
Do.....	Gun-lever axle-bearing bushing.....	Brass.....	16	.75	.....	1.25	
Do.....	Hinge of azimuth pointer to racer.....	do.....	3	.5	.....	1	For carriages 36, 37, 38.
Do.....	Index slide and nut for azimuth pointer.....	do.....	8	.625	.....	.75	
Do.....	Notch number plate.....	Bronze.....	6	.19	.....	.625	
Do.....	Pawl safety-latch dog to crosshead.....	Steel.....	3	.5	.....	2.3	
Do.....	Roller-bearing dust guard.....	Wrought iron.....	6	.25	.....	.5	
Do.....	Rope stop to retraction drum.....	Steel.....	2	.75	.....	1.3	For carriages 1 to 26, inclusive.
Do.....	do.....	do.....	2	.5	.....	1.75	Do.
Do.....	do.....	do.....	4	.75	.....	1.3	For carriages after 26.
Do.....	Screen of sight-stand and platform.....	Wrought iron.....	8	.375	.....	.25	
Do.....	Top-carriage liners.....	Brass.....	6	.375	.....	2.25	
Screw, fillister-head	Training rack to base ring.....	Wrought iron.....	54	.5	.....	1.6	
Do.....	Roller-bearing dust guard to chassis.....	do.....	6	.375	.....	1.35	
Do.....	Lanyard guide to gun.....	Steel.....	2	.312($\frac{1}{8}$)	.....	.68	
Screw, headless.....	Securing gun-lever pins and suspension-rod pins in crosshead.....	Wrought iron.....	4	.75	.....	1	
Do.....	Traversing - pinion shaft.....	do.....	2	.5	.....	.75	
Do.....	Traversing intermediate shaft.....	do.....	2	.5	.....	.75	
Do.....	Securing stays and pin in roller frames.....	do.....	60	.5	.....	.9	
Do.....	Retraction spur-gear hub.....	do.....	1	.5	.....	.75	
Do.....	Worm-shaft bushing.....	do.....	1	.5	.....	.75	
Do.....	Hubs of handwheels and elevation disks.....	do.....	3	.5	.....	.75	
Do.....	Securing bushing in gun lever, cross-head bearing.....	do.....	2	.5	.....	1.5	
Do.....	Valve stem and yoke.....	do.....	1	.375	.....	.9	
Do.....	Securing bushing in left chassis at worm-shaft bearing.....	do.....	1	.5	.....	.75	
Screw, headless set.	Retraction - shaft handwheel.....	Steel.....	1	.5	.....	.6	
Do.....	Traversing pinion and traversing crank shaft.....	do.....	1	.75	.....	1.375	
Screw, hexagon-head set.	Collar for handwheel shaft.....	do.....	1	.5	.....	1	
Do.....	Collar for retraction-drum shaft.....	do.....	1	.75	.....	1.5	
Do.....	Sight-standard collar.....	do.....	2	.1	.....	.....	Set screws.
Do.....	do.....	do.....	3	.75	.....	2.25	Steel screws.
Screw, hexagon-head.	Traversing - roller caps.....	do.....	16	.625	.....	1.5	.875 flats.
Screw, hexagon-head set.	Collar for traversing crank shaft.....	Steel.....	1	.5	.....	1.25	
Do.....	Thrust collar on worm-wheel shaft.....	do.....	1	.75	.....	2	
Do.....	Tripping lever.....	do.....	2	.5	.....	.75	
Screw, roundhead..	Azimuth pointer.....	Brass.....	2	.25	.....	7	For carriages Nos. 1. to 35, inclusive.
Do.....	Ball-bearing cover.....	do.....	3	.125	.....	.25	
Do.....	Grease-cup plunger.....	do.....	6	$\frac{1}{8}$	.....	.5	
Do.....	Name plate.....	do.....	2	.25	.....	.5	
Do.....	Side-covering plates on worm-wheel casing.....	do.....	10	.25	.....	.5	

List of parts—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
Screw driver.....	With carriage.....	Steel.....	2				1 with wood handle.
Separator.....	Between distance rings.....	Cast iron.....	12				
Separator bolt.....	Through separator.....	Wrought iron.....	12	1		11.55	
(Shot tongs).....	With carriage.....		7				Consisting of arms, eye-piece, eye-piece pin, link, link pin, split pins, and washer.
Side-covering plate.....	Worm-wheel casing.....	Steel.....	2				Half-rings.
Side piece.....	Roller frame.....	Forged steel, No. 2.....	4				
Sight standard.....	On right piston-rod bracket.....	Cast steel, No. 1.....	1				
Sight-standard adjusting collar.....	Sight standard to chassis.....	Steel.....	1	5			
Sight-standard cap.....	On sight standard.....	Cast iron.....	2				
Sight-standard gib.....	Sight-standard cap.....	Steel.....	2				
Sight-standard platform.....	Rear of sight chassis.....	Wrought iron.....	1				
Sight-standard platform brace.....	do.....	do.....	2				1 pair.
Sight-standard platform guard rail.....	On sight-standard platform.....	do.....	1				0.75" and 1" pipe and fittings.
Sight-standard platform ladder.....	Rear of right chassis.....	do.....	1				
Sight-standard ladder brace.....	do.....	do.....	2				1 pair.
Single wrench.....	With carriage.....	Steel.....	1				For 1 1/2" nut.
Do.....	do.....	do.....	1				For 1 1/2" nut.
Sleeve.....	Elevation disk hub to worm-wheel shaft.....	do.....	1				
Slide.....	Azimuth pointer.....	Bronze.....	1				For carriages 36, 37, 38.
Spanner wrench.....	With carriage.....	Steel.....	1				
Split pin.....	Buffer-cap bolt.....	do.....	4	.25			
Do.....	Eye-piece pin.....	do.....	7	.1			
Do.....	Link pin.....	do.....	7	.125			
Do.....	Pawl-lever link pin.....	do.....	4	.25			
Do.....	Rope-pulley axle.....	do.....	2	.25			
Do.....	Small end of sleeve pins.....	do.....	2	.156	1		
Spring.....	Grease-cup plunger.....	Spring steel.....	6				5 coils.
Stay.....	Roller frame.....	Steel.....	22				
Stop.....	On outside of right chassis.....	Wrought iron.....	1				
Do.....	On outside of left chassis.....	do.....	1				
Stop.....	In base ring to limit traversing.....	Steel.....	2				
Stud.....	Caps for gun levers.....	Wrought iron.....	4	1.75		8	
Do.....	Elevating-arm caps.....	do.....	4	1		5	
Do.....	Racer for azimuth-pointer body.....	do.....	2	.5		1.8	For carriages 36, 37, 38.
Do.....	Rear cylinder heads.....	do.....	24	.75		3.6	
Do.....	Top-carriage cap-square.....	do.....	4	1.5		8.5	
Suspension rod.....	Crosshead.....	Forged steel, No. 3.....	2				
Suspension-rod nut.....	Suspension rods.....	do.....	2				4 halves.
Suspension-rod pin.....	do.....	do.....	2				
Taper pin.....	Elevation pointer to elevation-pointer bracket.....	Steel.....	2	.208		1.25	
Do.....	Retraction-crank shaft coupling.....	do.....	2	.4		3.75	
Do.....	Sleeve to worm-wheel shaft.....	do.....	2	.281		5.625	
Throttling bar.....	In recoil cylinders.....	Forged steel.....	4				2 right, 2 left.
(Throttling valve).....	Equalizing pipe.....		1				Consisting of throttling-valve body, valve seat, valve stem, follower, gland, yoke, latch, rivet, packing, coupling, Yale lock, and headless screw.

List of parts—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
Throttling-valve body.	Throttling valve.....	Bronze.....	1				
Thrust disk.....	In worm-wheel casing.	Hardened steel.....	1				
Thrust collar.....	Worm-wheel shaft.....	Steel.....	1	5	2.75	1.5	
Thrust plate.....	Under leveling screws in basing ring.	do.....	12				
Thrust washer.....	Friction clamp on worm-wheel shaft.	Balata and bronze.....	1				
Tie plate.....	Inner distance ring..	Wrought iron.....	2				
Do.....	Outer distance ring..	do.....	2				
Do.....	Dust guard for traversing roller.	do.....	6				
Top carriage.....	On chassis.....	Cast iron.....	1				
Top-carriage platform.	On right recoil cylinder.	Wrought iron.....	1				
Top-carriage platform brace.	Platform to top carriage.	do.....	1				
Top-carriage platform ladder.	Top-carriage platform.	do.....	1				
Top-carriage ladder brace.	Ladder to top carriage.	do.....	2				1 right, 1 left.
Top-carriage platform rail.	On top carriage platform.	do.....	1				
Training rack.....	Attached to base ring.	Forged steel.....	1				6 pieces, 260 teeth.
Transom.....	Between chassis.....	Cast steel, No. 1.	1				For carriages 1 to 26, inclusive.
Do.....	do.....	do.....	1				For carriages after 26.
Traversing - crank shaft.	Across front of chassis.	Steel.....	1				
Traversing direction plates.	On side of chassis....	Bronze.....	2				1 right, 1 left.
Traversing gear....	On outer end of traversing intermediate shaft.	do.....	1				4 teeth.
Traversing bracket.	On racer.....	Cast iron.....	1				
Traversing intermediate shaft.	At front end of right chassis, horizontal.	Steel.....	1				
Traversing pinion..	On traversing-pinion shaft.	Bronze.....	1		3.25		12 teeth.
Do.....	On traversing crank shaft.	Steel.....	1		3.5		18 teeth
Traversing-pinion shaft.	At front end of right chassis, vertical.	do.....	1				
Traversing roller...	Between base ring and racer.	Forged steel, No. 3.	24				
Traversing - roller caps.	2 under each sixth traversing roller.	Wrought iron.....	8				
Tripping-bar hook..	On sides of chassis....	do.....	4				
Tripping lever.....	Ends of tripping shaft.	Steel.....	2				
Tripping-lever rest.	Floor plate.....	do.....	2				
Tripping shaft.....	Front of chassis.....	do.....	1				
Trip pin-g-shaft bracket.	do.....	Cast iron.....	2				
Valve seat.....	Throttling valve.....	Steel.....	1				
Valve stem.....	do.....	Steel and bronze.	1				Valve riveted into stem with 0.19" brass rivet.
Washer.....	Elevation pointer to bracket.	Steel.....	2	1.125	.5	.125	
Do.....	Elevating-rack buffer.	do.....	2	3.5	1.25	.5	
Do.....	Emptying plug.....	do.....	1	1.5	1	.25	
Do.....	Eyepiece pin.....	do.....	7	1.5	.75	.25	
Do.....	Grease-cup plunger..	do.....	6	1.4	.4	.12	
Do.....	Pawl safety-latch fulcrum.	do.....	1	1.6	.9	.2	
Do.....	Roller-bearing dust guard.	do.....	1	5	2.55	.25	
Do.....	do.....	do.....	1	5	2.3	.25	
Do.....	do.....	Felt.....	2	3.7		.35	
Do.....	Rope pulley axle....	Steel.....	2	2	1.4	.25	
Do.....	Stud for azimuth-pointer body.	do.....	2	1.1	.5	.1	
Do.....	Throttling-bar bolts.	Lead.....	28	1.5	.75	.05	
Do.....	do.....	Steel.....	28	1.5	.75	.2	
Worm-shaft bushing.	Worm-wheel casing.	Bronze.....	1				For carriages 36, 37, 38.

List of parts—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
Worm wheel.....	Worm-wheel shaft..	Bronze.....	1	.....	.....	.....	20 teeth.
Worm-wheel casing	On rear of racer ..	Cast iron, No. 2.	1	.....	.....	.....	In 2 parts.
Worm-wheel shaft.	Through chassis.....	Forged steel, No. 3.	.....	.....	.....	.....
Worm and shaft...	Elevating gear.....	do.....	1	.....	.....	.....
Wrench.....	With carriage.....	Steel.....	1	.....	.....	.....	For cylinder heads and filling plugs.
Do.....	do.....	do.....	2	.....	.....	.....	For piston-rod nuts.
Yale standard pad-lock, No. 853.	Throttling valve.....	.....	1	.....	.....	.....

AMMUNITION TRUCK.

[Three trucks for each carriage.]

Ball.....	Elevating-screw ball bearing.	Steel.....	30	.5	.....	.....
Do.....	Caster ball bearing..	do.....	38	1	.....	.....
Ball washer.....	do.....	Hardened steel.	2	.....	.....	.....	Upper and lower halves.
Do.....	Elevating-screw ball bearing.	do.....	2	.....	.....	.....	Do.
Bolt, hexagon head	Brake-shaft bracket to frame.	Wrought iron	4	.5	.....	1.25	
Do.....	Crank-shaft bracket to frame.	do.....	4	.5	.....	1.2	
Do.....	Caster bracket.....	do.....	4	.75	.....	1.6	
Do.....	Front axle to frame..	do.....	3	.75	.....	2.75	
Bolt, tap.....	Caster bracket.....	do.....	2	.75	.....	1.25	
Do.....	Lever center.....	do.....	1	.5	.....	1.75	
Brake lever.....	Brake shaft.....	Steel.....	1	.....	.....	.....
Brake-lever guide..	Lower rear part of frame.	do.....	1	.....	.....	.....
Brake-lever spring.	Spring hook and brake lever.	do.....	1	.....	.....	.....	19.5 coils.
Brake shaft.....	Brake-shaft bracket.	do.....	1	.....	.....	.....
Brake-shaft bracket.	Lower front part of frame.	Bronze.....	2	.....	.....	.....	1 right, 1 left.
Brake shoe.....	Brake shaft.....	Cast steel.....	2	.....	.....	.....	Do.
Buffer.....	Body.....	do.....	1	.....	.....	.....
Do.....	Bushing.....	Steel.....	1	.....	.....	.....
Do.....	Cap.....	Bronze.....	1	.....	.....	.....
Do.....	Cylinder head.....	do.....	1	.....	.....	.....
Do.....	Filling and drain plug.	Steel.....	2	.....	.....	.....
Do.....	Follower.....	Bronze.....	2	.....	.....	.....
Do.....	Gland.....	do.....	2	.....	.....	.....
Do.....	Pin.....	Steel.....	1	.375	.....	.....
Do.....	Spring.....	do.....	1	.....	.....	.....
Bushing.....	Caster bracket.....	Bronze.....	2	1.5	1.25	3.375	
Do.....	Caster wheels.....	do.....	2	1.5	1.25	2.125	
Do.....	Front wheels.....	do.....	2	1.75	1.5	2.25	
Do.....	Guide ring.....	do.....	2	2.25	1.85	1.24	
Do.....	Screw support.....	do.....	2	2.25	1.85	2	
Cartridge shelf.....	On sides of truck.....	Steel.....	2	.....	.....	.....	1 right, 1 left.
Cartridge support..	Under front ends of cartridge shelf.	do.....	2	.....	.....	.....	1" x 1" x 1/2" angle.
Do.....	Under rear ends of cartridge shelves.	do.....	2	.....	.....	.....	1 right, 1 left.
(Caster ball bearing.)	Caster yoke.....	.....	2	.....	.....	.....	Consisting of ball washers, bells, cover, and screws.
Caster bracket.....	Connecting caster yokes to body of truck.	Cast steel.....	2	.....	.....	.....	1 right, 1 left.
Caster pin.....	Through caster yokes.	Steel.....	2	.....	.....	.....
Caster wheel.....	Rear of truck.....	Cast steel.....	2	.....	.....	.....
Caster yoke.....	Caster wheels.....	do.....	2	.....	.....	.....	Do.
Center shaft.....	Upper part of body of truck.	Steel.....	1	.....	.....	.....
Clutch gear.....	Rear elevating screw	Bronze.....	1	.....	.....	.....	48 teeth.
Clutch lever.....	Clutch gear and lever center.	Steel.....	1	.....	.....	.....

List of parts—Continued.

AMMUNITION TRUCK—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
Clutch ring.....	Nut on rear elevating screw.	Steel.....	1				
Cover.....	Elevating-screw ball bearing.	Bronze.....	2				
Do.....	Caster ball bearing.	do.....	2				
Crank.....	Crank shaft.	Wroughtiron.	1				With brass screws and washer.
Crank shaft.....	Upper part of body truck.	Steel.....	1				
C r a n k - s h a f t bracket.	Bearing crank shaft.	Bronze.....	1				
Elevating screw...	Carrying shot tray.	Steel.....	2				Both right hand.
(Elevating - screw ball bearing.)	Elevating screws.	do.....	2				Consisting of balls, ball washers, cover, and screws.
Filling-in piece....	At hinge for handles.	Wroughtiron.	2				
Filler piece.....	Rear end of shot tray	Cast steel.....	1				
Filler-piece hinge..	do.....	do.....	1				
Filler-piece hinge pin.	do.....	Bronze.....	1				
Frame.....	Forming body of truck.	Steel.....	1				
Do.....	Under screw support.	do.....	2				1 right, 1 left.
Front axle.....	At base of truck.	Forged steel..	1				
Front wheel.....	On front axle.	Cast steel.....	2				
Guide ring.....	In top plate.	Forged steel..	2				
Handle.....	Clutch lever.	Steel.....	1				
Hinge for handles..	Attaching truck handles to truck.	Wroughtiron.	2				Riveted to frame; 1 right, 1 left.
Hinge pin.....	Hinges for handles.	do.....	1	.75		12	
Intermediate gear..	On miter gear hub.	Steel.....	1				24 teeth.
Key, square.....	Brake lever and brake shaft.	do.....	1	.3		1.75	
Do.....	Brake shoe and brake shaft.	do.....	2	.25		2	
Do.....	Miter and intermediate gears.	do.....	1	.25		1	
Do.....	Miter gear to crank shaft.	do.....	1	.25		1	
Do.....	Nut and clutch ring.	do.....	1	.25		2.25	
Lever center.....	Crank-shaft bracket.	Bronze.....	1				
Lever spring.....	Frame, end of clutch lever.	Steel.....	1				
Miter gear.....	Crank shaft and center shaft.	Bronze.....	2				27 teeth.
Nut.....	Bolt, brake-shaft bracket to frame.	Wroughtiron.	4	.5		.5	
Do.....	Bolt, caster bracket.	do.....	4	.75		.75	
Do.....	Bolt, crank-shaft bracket to frame.	do.....	4	.5		.5	
Do.....	Bolt, front axle to frame.	do.....	3	.75		.75	
Do.....	Caster pins.	do.....	2	1		.75	
Do.....	Caster yokes.	do.....	2	1		1	
Do.....	Center shaft.	do.....	1	.75		.75	
Do.....	Front axle.	do.....	2	1		.75	
Do.....	Handle for clutch lever.	do.....	1	.5		.5	
Do.....	Rear elevating screw	Bronze.....	1				
Oil plug.....	Brake-shaft bracket.	Brass.....	2	.375			
Do.....	Caster wheels.	do.....	2	.375			
Do.....	Caster yokes.	do.....	2	.375			
Do.....	Center shaft.	do.....	1	.375			
Do.....	Crank-shaft bracket.	do.....	1	.375			
Do.....	Front wheels.	do.....	2	.375			
Screw, headless...	Brake shoe and brake shaft.	Steel.....	2	.5		.75	
Screw, hexagon head, set.	Brake lever and brake shaft.	do.....	1	.5		.75	
Screw, roundhead.	Covers for ball bearings.	Brass.....	12	.125		.25	
Do.....	Lever spring to screw support.	Wroughtiron.	2	.375		.7	
Screw support.....	Upper part of frame.	Steel.....	1				
Shot tray.....	On elevating screws.	do.....	1				
Shot-tray pin.....	Connecting shot tray to elevating screws.	Bronze.....	2	1		4.5	
Sleeve.....	Center shaft.	Steel.....	1	1.75	.75	3	

List of parts—Continued.

AMMUNITION TRUCK—Continued.

Name of part.	Location.	a.	b.	c.	d.	e.	Remarks.
Split pin.....	Caster pin.....	Steel.....	2	.25			
Do.....	Crank and crank shaft.	do.....	1	.25			
Do.....	Filler-piece hinge pin	do.....	1	.25			
Do.....	Front axle.....	do.....	2	.25			
Do.....	Handle for clutch lever.	do.....	1	.125			
Do.....	Hinge pin.....	do.....	2	.25			
Do.....	Shot-tray pin.....	do.....	2	.25			
Spring hook.....	Front part of frame.	do.....	1				
Spur-wheel.....	Front letter elevating screw.	Bronze.....	1				48 teeth.
Stop.....	For handles.....	Steel.....	1				Riveted at rear of frame.
Tire.....	Caster wheels.....	Rubber.....	2				
Do.....	Front wheels.....	do.....	2				
Top plate.....	Top of body of truck.	Steel.....	1				
Tray support.....	Breech end of shot tray.	Bronze.....	1				
Truck handle.....	Rear of truck.....	Wroughtiron and wood.	1				
Washer.....	Caster yoke.....	Steel.....	2	2.5	1	.25	
Do.....	Front axle.....	do.....	2	2.5	1	2.5	
Do.....	Hinge pin.....	do.....	2	1.75	.75	.25	

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